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**Front cover:** Fly Orchid *Ophrys insectifera*, a rare plant of Ellerburn Bank YWT reserve in the North York Moors (see p97). Photo: *P. Mayhew.*

**Back cover:** *Potamogeton lucens* bed in Malham Tarn, looking towards Tarn House and the East Boathouse (see p126). Photo: *S. Flint*.

# HEALTH AND SAFETY GUIDANCE

## Potential hazards and procedures to consider before starting any field work or wildlife survey

**Please spend a few minutes reading this guidance. If you have any questions, please ask the organiser/leader. Health and safety is an individual's responsibility and each person is responsible for drawing the attention of the group to any hazard observed during the course of the work.**

A risk assessment should be carried out before field work is started. Consider the following:

**General points**

Appropriate clothing. Consider the weather forecast and the terrain to be covered, including scrubby and prickly vegetation.
Sun protection cream, even in cloudy weather.
Sufficient drinking water, even on cool wet days.
Ensure supplies of any required medicine e.g. hay fever tablets. Diabetics should have adequate food and medication.
An up to date tetanus vaccination is advised.
Have a small first aid kit available.
Latex gloves are useful in handling biological material, e.g. dead animals or dung or when working in water.

**Working in pairs/lone working**

It is advisable to work in communicative pairs whilst surveying, i.e. in earshot of each other, but there are times when this is not possible. Consider the following issues:

- Be aware of your surroundings and be conscious of the dangers associated with the different natural habitats in which you are working, e.g. fissures in the ground hidden by vegetation, wet flushes and fallen wet timber. Many places are on steep slopes, be aware of cliffs or wet rocks or flushes. Remain aware of the surroundings of the site.
- Isolation: Check your mobile telephone is packed, charged and is within range of a mast. Carry a card for telephone boxes and have change available in case you need to ask another person to telephone on your behalf. Check the location of the nearest settlement.
- Advise a reliable contact of the exact site where you are working, its location and likely route and parking place. Advise the person of the estimated time you will leave the site. Most organisations have an agreed contingency plan should you not return. Call your contact on leaving the site.

**Surveying along roads and railways**

When surveying hedges or verges running along a road or a railway, consider the following:

- Wear fluorescent clothing for visibility.
- Try to keep off roads and work from the verge.
- Place warning signs 100m either side of a survey area where there is no verge. Consider the need for a look out.
- Remain aware of where you are.
- If the survey involves a railway, you need consent of Network Rail or other track owner.
-

**Fauna and flora**

Most wildlife and livestock are not a threat to humans or will avoid humans, but in some situations you may become bitten or be stung. Consider the following:

- Avoid startling animals and livestock where possible.
- Some plants and caterpillars release irritants and toxins.
- Are there deer or sheep in the area? If suspected, protect the skin from ticks to reduce the risk of Lyme Disease. Check yourself thoroughly after returning home. If you find ticks, remove them as soon as possible with a proprietary tick-removal device – do not use chemicals such as washing-up liquid, soap, or meths as these are more likely to cause the tick to expel bacteria into your bloodstream. Keep an eye on the affected area and if it develops into a 'bulls-eye' pattern, seek medical treatment quickly. Antibiotics will be needed to prevent Lyme Disease, which is a serious long-term condition if not dealt with.

- Bracken spores are carcinogenic. It is advisable to avoid bracken-covered areas from mid- July onwards.

**Water bodies**

- Consider the risks associated with water bodies and wet flushes, especially areas of soft mud with no vegetation in fens and bogs.
- Avoid steep banks which could allow you to slip into a water body. Be aware of becoming trapped in muddy conditions.
- If working close to a water body, it may be advisable to carry emergency flotation equipment or 'throw line'. Carry dry clothing and equipment to prevent hypothermia.
- Leptospirosis (Weil's disease): most commonly associated with rats, through bacteria in their urine, which can survive up to four weeks in water. Humans can become contaminated via infected urine, water or mud. Bacteria enter humans via cuts or through mucous membranes (e.g. eyes, mouth or nose). Simple precautions include cleansing and covering cuts with waterproof plasters. Avoid rubbing eyes, nose and mouth and wash hands thoroughly after the survey. If flu like symptoms develop within three to 19 days of the survey, contact a doctor and ask for an ELISA blood test. Other animals can carry the bacteria.

**Surveying at night.**

Such surveys should always be carried out in **communicative pairs**. Equipment should include primary and back-up torches as well as a whistle for each surveyor. Sites should be visited in daylight and a risk assessment carried out before night-time surveys are undertaken. Consider the following:

- It may be advisable to wear high visibility clothing
- Mark hazards with hi-viz tape, lamps or light sticks.
- Consider marking the way to the survey site.
- If using a generator, follow the manufacturer's safety instructions.

**Insurance**

Some landowners require the surveyor to have insurance or indemnification. The organiser is responsible for ensuring such insurance is in place.

The guidance given above is based on appendix II of the *Hedgerow Survey Handbook* by Catherine J. Bickmore. English Nature, Peterborough.

**Risk assessment**

Some definitions:

- An accident is an unforeseeable event. Most incidents that occur during surveys are not accidents.

- A hazard is an object, which is capable of causing harm to people.
- A risk occurs when somebody is exposed to a hazard that causes serious harm, is in close proximity to a hazard or is exposed to a hazard for an extended period of time.

Five steps to risk assessments:

1. Identify hazards
2. Identify who is at risk from hazards identified
3. Establish how hazards can be removed or risk of injury reduced.
4. Record steps 1-3 above
5. Review the risk assessment periodically in the light of working experience.

**Each surveyor should take part in the risk assessment process. Surveys should only go ahead if measures could be taken to reduce risks to an acceptable level.**

*All incidents must be reported to the survey leader, who should record the incident in writing.*

## BIO-SECURITY GUIDANCE

In the past few years, there have been a number of outbreaks of disease amongst farm animals. We ask that field naturalists working in areas where farm animals are present should obey the following guidelines:

- If visiting farmland by car, try to avoid parking in a farmyard where animals are kept. Try to park on hard standing, not in muddy gateways, likely to be used by animals.
- Avoid touching farm animals or deer. Always wash your hands if an animal is touched.
- Clean mud from boots and/ or your car after each farm visit.
- In areas of potential high risk, wash/ spray your boots with an approved disinfectant (see the Defra website for a list of suitable disinfectants obtainable from an agricultural merchant).
- Seek permission from the farmer to enter premises or fields.
- We also alert you to an increase in Lyme Disease from ticks. The number of cases has doubled in the past two years. Should you have difficulty removing a tick or suffer from a fever after a tick, seek medical assistance and ask for a Lyme disease test.

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# From Yorkshire to China via Borneo: a biological excursion through tropical moth ecology

*The Presidential Address delivered following the Annual General Meeting at Malham Tarn Field Centre, 15th November 2014.*

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In this address I hope to introduce you to some of the questions about moth species distributions and population diversities that I have had a minor part in helping study in South-east Asia. Some Yorkshire-born or based researchers have played a major part in researching the associated ecology, especially Dr. Stephen Sutton, a past YNU President; more recently by the research group of Professor Roger Kitching of Brisbane, Australia. Many of the questions have not been fully answered yet.

**The Big Questions:**

1) What is the moth diversity in various biotopes?
    1b) Does it depend on the biotope involved?
    1c) What is the taxonomic structure of the species composition?
    1d) How many moth species are there in Borneo?
2) Which areas & biotopes have the highest diversities?
3) How does moth diversity change with geographic distances?
    3a) At what geographic scale?
    3b) Are moths stratified vertically(ground to canopy)?
    3c) How does moth diversity change temporally?
    3d) How does moth diversity change on altitudinal transects?

3e) How does moth diversity change on latitudinal transects within forest biotopes?
3f) How do patterns of moth diversity change between continents?

**Biodiversity: the importance of robust data (and big numbers)**

A variety of objective measures have been created in order to measure biodiversity empirically. The basic idea of a diversity index is to obtain a quantitative estimate of biological variability that can be used to compare biological entities, composed of direct components, in space or in time. Indirectly this can be used to estimate the number of species.

The term alpha diversity (α-diversity = within habitat diversity) was introduced by Whittaker (1960, 1972) together with the terms beta diversity (β-diversity= between habitat diversity) and gamma diversity (γ-diversity = whole landscape diversity (a larger geographical unit)). Whittaker's idea was that γ-diversity is determined by two different things, the mean species diversity in sites or habitats at a more local scale (α-diversity) and the rate of change within those habitats (β-diversity). Definitions of α-diversity can also differ in what they assume diversity to be. Often researchers use the values given by one or more diversity indices, such as species richness, by the Shannon index or the Simpson index. Species richness is the number of different species represented in an ecological community, landscape or region. It is simply a count and does not take into account abundances, relative abundance distributions or the rarity of individuals, whereas biodiversity can. However, it has been argued that it would be better to use the effective number of species as the universal measure of species diversity. This measure allows weighting of rare and abundant species in different ways, just as the diversity indices collectively do, but its meaning is intuitively easier to understand. The effective number of species is the number of equally abundant species needed to obtain the same mean proportional species abundance as that observed in the dataset of interest (where all species are not equally abundant) (Hill, 1973; Jost, 2007; Tuomisto, 2010). It is important to distinguish 'richness' from 'diversity'. Diversity usually implies a measure of both species number and 'equitability' (or 'evenness'). Fisher's logarithmic series model (Fisher *et al*. 1943), log Series α distribution (like the more commonly used Poisson log series) describes the relationship between the number of species and the number of individuals of those species, and is one measure that has been commonly adopted (Taylor *et al.,* 1976) which I am going to use to introduce some of the concepts of species diversity in moths. At its simplest for a sample of a given number of individuals the diversity will be highest in the sample containing the greater number of groups (species). In the tropics moth species rank abundance curves from the most diverse sites and the least diverse sites show similar inverse exponential curves but they differ markedly in detail. The former have few abundant species and a long tail of rare ones whereas less diverse sites have several abundant species and many fewer scarce ones. In order to compare biodiversity of samples from different locations it was necessary to elucidate the statistics of sampling and a measure was needed to understand species-richness expressed in a way that was independent of samples size (Robinson & Tuck 1993a, 1996). This led to the use of rarefaction curves (Sanders 1968).

**1a. What is the moth diversity in various biotopes?**

The first people to estimate moth species richness in SE Asia were Barlow and Woiwod (1989, 1990) and they were the first to consider the contribution of 'micro-moths' to diversity. Their samples proved what had been suspected, that the values of α-diversity of moths in tropical

forests could be extremely high (Table 1). This was confirmed by Holloway *et al.* (1990), who obtained an α-diversity value of 309 for macrolepidoptera in lowland dipterocarp forest in Sarawak. Robinson & Tuck (1993a, 1996) found that micromoths from two primary forest sites in Brunei were particularly diverse, showing α-diversity values of 414 in pooled samples. Diversity will also vary within an order related to the infra-ordinal taxonomic status of the sample group. Samples restricted to micromoths, macromoths or pyralids will show lower values of α than those counting all moths (Table 1). Sample size is important but larger samples will have greater diversity values, especially in highly diverse places. This effect is the result of casual migration and an increasing opportunity for rare moths from a wider area to be captured over a longer time period. In effect, collecting is an open-ended enterprise. In practice, samples greater than 1000 individuals tend to have stabilized variances and were thought to provide useful 'snapshot' measures of diversity.

Holloway *et al.* (1992) and Chey *et al.* (1997) used pooled samples of fewer than 900 individuals from single locations, which seemed to show that primary natural forest in Danum Valley had a low moth diversity leading to the assertion that α-diversity at Danum appeared to be lower than that recorded in other Bornean primary forests but similar to disturbed forest habitats in Brumas. Also, nine equally spaced sample sites within 1.5km in the Danum Valley Conservation area sampled by Beck *et al.* (2006) showed a very low α-diversity of only 14.5 ± 2.9. It was based on only 1596 geometrids (127 species) and his conclusion, that one sample in an area of 225ha for the investigated taxon is representative, is now considered totally unjustified. This is refuted here as Table 2 (from Willott *et al.* unpubl.) demonstrates, α for the pyraloids (186) is similar to that recorded from Brunei (203) (Robinson & Tuck, 1993a) and higher than for Peninsular Malaysia (91) (Barlow & Woiwod, 1989), although another study based on small samples and methodological differences between the latter and the collections from Borneo makes comparisons difficult. Similar criticism of measurements based on very small numbers can be applied to some of the α-diversity values from West Java reported by Sutrisino (2008).

The monumental dataset collected by Henry Barlow and analysis based on the staggering number of 70,529 individuals of Macros and Pyraloidea plus Thyridoidea should draw some of the above arguments to a close (Ashton *et al.*, 2014). The authors say that there is no substitute for long-term 'old fashioned' accumulation of data. Snapshot surveys will only provide a relative measure of species richness.

To put the α-diversity figures in Table 1 into context: in Yorkshire (with c.500 species of macromoths) the richest sites have an α-diversity of value <41 (Sutton & Beaumont 1989, Anon 1996). An α-diversity of 40 would represent 221 species for every 10,000 individuals sampled. In contrast the mean UK α-diversity of Pyraloidea is 2.9 whereas at Genting it is 91 (Barlow & Woiwod 1989). In comparison considering the Brunei case an α-diversity of 414 suggests c.1,333 species of microlepidoptera occur near the Batu Api Forest Reserve sites (Robinson & Tuck 1993a,b; 1996).

Table 1. Some estimates of moth diversity in South-east Asia.

| Location | Biotope | Altitude m | Trapped Types | α-diversity ± S.E. | Study Reference |
|---|---|---|---|---|---|
| W. Malaysia, Genting | **S*** | 150 | h | 309 | Holloway 1987 |
| W. Malaysia, Genting | **S*** | 650 | hmp | 386 ± 11 | Barlow & Woiwod 1989 |
| W. Malaysia, Genting | **S*** | 650 | p | 91 ± 5 | Barlow & Woiwod 1989 (in Schulze 2000) |
| Sarawak | **P1** | 150 | h | 309 | Holloway *et al.* 1990 |
| Sulawesi, Dumoga-Bone NP | **P1** | 225 | hp | 303.1 ±9.2 | Barlow & Woiwod 1990 |
| Sulawesi, Dumoga-Bone NP | **P1*** | 225 | hp | 234.5 ± 9.4 | Barlow & Woiwod 1990 |
| Brunei, Kuala Belalong 1 | **P1** | 125 | mp | 355 ± 46 | Robinson & Tuck 1993a |
| Brunei, Kuala Belalong 2 | **P1** | 125 | mp | 413 ± 74 | Robinson & Tuck 1993a |
| Brunei, Kuala Belalong 1+2 | **P1** | 125 | mp | 414 ± 39 | Robinson & Tuck 1993b |
| Brunei, Kuala Belalong 1 | **P1** | 125 | p | 193 ± 35 | Robinson & Tuck 1993a |
| Brunei, Kuala Belalong 2 | **P1** | 125 | p | 218 ± 46 | Robinson & Tuck 1993a |
| Brunei, Kuala Belalong 1+2 | **P1** | 125 | p | 203 ± 25 | Robinson & Tuck 1993b |
| Brunei, Kuala Belalong 1+2 | **P1** | 125 | mp | 216 ± 32 | Robinson & Tuck 1993a |
| Brunei, Kuala Belalong 2 | **P1** | 125 | m | 222 ± 77 | Robinson & Tuck 1993a |
| Brunei, Kg. Kapok 1 | **M** | 0 | p | 39 ± 19 | Robinson & Tuck 1993a |
| Brunei, Kg. Kapok 2 | **M** | 0 | p | 56 ± 9 | Robinson & Tuck 1993a |
| Brunei, Kg. Kapok (1+2) | **M** | 0 | p | 69 ± 11 | Robinson & Tuck 1993a |
| Brunei, Kg. Kapok (1+2) | **M** | 0 | p | 120 ± 13 | Robinson & Tuck 1993b |
| Brunei, Kg. Kapok, | **M** | 0 | mp | 47 ± 11 | Robinson & Tuck 1993a |
| Brunei, Kg. Kapok | **M** | 0 | mp | 105 ± 13 | Robinson & Tuck 1993a |
| Brunei, Kg. Kapok | **M** | 0 | mp | 120 ± 13 | Robinson & Tuck 1993a |
| Sabah, Crocker Range | **P3** | 1500 | mp | 226 ± 35 | Robinson & Tuck 1993a, 1996 |
| Sabah, Crocker Range | **P3** | 1500 | p | 64 ± 20 | Robinson & Tuck 1993a, 1996 |
| Temengor, W. Malaysia | **P1** | 275 | p | 120 ± 24 | Robinson *et al.* 1995 |
| Sabah, Danum Valley | **P1** | 125-150 | h | 292 ± 14 | Willott 1999 |
| Sabah, Danum Valley | **L** | 125-150 | h | 234 ± 15 | Willott 1999 |
| Sabah, Danum Valley | **PC** | 150 | h | 244 ± 15 | Willott 1999 |
| Sabah, Poring (Por1)) | **PC** | 580 | p | 129±13 | Schulze 2000 |
| Sabah, Poring (Por2) | **P1** | 630 | p | 147±13 | Schulze 2000 |
| Sabah, Poring (Por3) | **L** | 600 | p | 138±20 | Schulze 2000 |
| China, Xishuangbanna | **PA*** | 600-800 | | 255±7.15 | Kitching *et al.* (2015) |
| China, Xishuangbanna | **PL** | 600-800 | | 292±8.32 | Kitching *et al.* (2015) |
| W. Malaysia Sg. Halong | **P2** | 311 | hp | 821.7±8 | Ashton *et al.* (2015a in press) |
| W. Malaysia, Genting 1980 | **S*** | 650 | hp | 469.7±7 | Ashton *et al.* (2015a in press) |
| W. Malaysia, Genting 2000 | **S*** | 650 | hp | 337.6±9.5 | Ashton *et al.* (2015a in press) |
| Sabah, BRL | **PA** | 58 | hp | 742.7±9 | Ashton *et al.* (2015a in press) |

KEY **P1** = *primary lowland forest*; **P2** *primary hill forest*; **P3** *primary submontane forest*; **PC** *primary lowland forest canopy*; **PA** = *primary alluvial lowland forest*; **PL** = *primary lowland forest on limestone*; **L** = *logged over forest*; **S** = Secondary Forest (Mature); **M** = *Mangrove Forest*; ***** *disturbance present*; h = *macro-Lepidoptera*; m = *micro-Lepidoptera* sensu stricto; p = *Pyraloidea*.

**1b. Does it depend on the biotope involved?**

Beck *et al.* (2002) presented geometrid data along two habitat gradients ranging from primary rainforest to cultivated land in Sabah, North Borneo. The moth diversity in the forest plantations such as *Acacia mangium*, *Gmelina arborea*, *Paraserianthes falcataria*, *Pinus caribaea* and *Eucalyptus deglupta*, is unexpectedly high. Moth diversity in the *E. deglupta* plantation was particularly high and comparable to that in old-growth secondary forest, possibly because this plantation has a very diverse understorey both in terms of plants (secondary regrowth species) and architecture. Disturbed tropical forest usually shows lower α-diversity (but higher β-diversity) and peat swamp forests also show lower α-diversity (Holloway 1992; Chey 1994, 2000, Chey *et al.* 1997; Schulze 2000; Fiedler & Schulze 2004). In some other woodland biotopes such as mangrove forests, oil palm and agricultural landscapes, α-diversity is inherently very low, reflecting the smaller pool of specialist moths dependent on the lower vegetational diversity and the simpler forest architecture (Table 1, Robinson & Tuck, 1993a,b, 1996; Willott, 1999; Beck *et al.*, 2002). Kitching *et al.* (2015) found that faunas in lowland alluvial forest and limestone forest in China (Yunnan, Xishuangbanna) had similar α and β-diversities and comparable moth species compositions. Submontane forest sites can show quite high α-diversities until the vegetation changes and it becomes depauperate in the higher altitude montane forests.

In trying to estimate how many moths were restricted to primary forest (a presence - absence criterion), Willott (1999) showed that c.55% were not sampled in primary forest and 11% were only encountered in logged forest. The proportion changed if moths with a minimum abundance were excluded. If this was restricted to those represented by at least ten individuals it suggested that at least 10% were confined to primary forest while <1% were restricted to logged-over forest. Unpublished data from the Whitaker & Kitching (2008) study did not confirm this over a larger geographic scale. 602 of 2283 morphospecies (26%) were unique to secondary and 537 (24%) confined to primary forest. A morphospecies is an unidentified taxon close to species level which can be reliably distinguished by external appearance. However, as primary forest samples are typified by a large number of rare moths represented by only singletons this may not be a realistic measurement. Species totals in primary and post-logging secondary forests confirm that each forest type presents similar levels of species richness (Hamer *et al.* 2003, Kitching *et al.* 2012, Willott 1999) but these are not composed of the same species. Deaton (1993 unpubl.) showed similar results (but with limited data) when comparing primary, secondary and heath forest (kerangas) at Barito Ulu, Kalimantan.

**1c. What is the taxonomic structure of the species composition?**

As reported by many authors working worldwide in perhumid tropical forests, micromoths of the superfamily Geometroidea, Crambidae plus Pyraloidea (*sensu* Regier *et al.* 2012) and Noctuoidea were known to form a large proportion of all tropical forest moths and the fauna is dominated by these and other tympanate moth families (e.g. Sutrisino 2008). After recent major taxonomic changes following DNA sequencing studies (Zahiri *et al.* 2011), the quadrifid Noctuoidea (traditionally divided into the Noctuidae, Lymantridae and Arctidae (LAQ clade)) is now partitioned into the Erebidae. This forms a large family with 21 subfamilies and several as yet unassigned groupings which contain the lymantrids, arctiids and other parts of the LAQ clade (especially the catocalids, originally considered with the Noctuidae). To illustrate this, Whitaker

& Kitching working at 10 sites in primary (virgin) tropical forest and disturbed (logged-over) forest in Sabah (North Borneo), constructed a morphoseries from 14,013 specimens captured in Pennsylvania-pattern actinic light traps (Kitching *et al.* 2005). Those that were identifiable were allocated to 39 'families'. Converting the dataset to reflect modern taxonomy, the tympanate families Erebidae (36.8%), Geometridae (14.1%), and the Pyraloidea (20.7% (Crambidae 14.2% and Pyralidae 6.5%)) were found to make up the majority (72%) of the taxa caught. The other tympanate families contributed less than 2.1% individually (Notodontidae (1.9), Noctuidae (1.3%), Nolidae (1.2%) and Uraniidae (0.9)) as did the non-tympanate families with the exception of the Limacodidae (7.0%) and Drepanidae (4.1%). There was no significant difference in familial composition between primary and disturbed forest samples.

**1d. How many moth species are there in Borneo?**

This question has been asked of many geographic areas and for the apocryphally speciose tropical forest it was undoubtedly a very large number. Holloway (1987), using his experience of the region, initially suggested a total of 4,500 larger moths in Borneo. Initial estimates were made by intuition, a variety of indirect sampling methods (which have been refined in time with repeated sampling and improved statistical treatments such as the Chao 1 estimator (Chao, 1984)) and cumulative catalogues of species and morphotypes. As an example, Robinson & Tuck (1993a,b) initially estimated that α-diversities of macrolepidoptera, Pyraloidea and microlepidoptera of 310, 170 and 210 respectively, suggested c.3,750 moths occur in lowland Bornean forest and, extrapolating from a number of taxonomic and field observations, suggested a Bornean total for all moths of 8,628 species (3,614 macrolepidoptera and 5,014 microlepidoptera) (Robinson & Tuck, 1993a,b, 1996). Holloway (1986-2011) produced a list of 4,563 macromoths which, combined with 936 butterflies and c.6,331 microlepidoptera, gave a minimum total of 11,830 lepidoptera. The conclusion to his massive revision of the taxonomy of Bornean macromoths amended this to an estimated total of 12,684, which was revised to 12,777 using data in Ashton *et al.* (2014). This may still be an underestimate as Pyraloid micromoths alone probably total in excess of 3,000 species (Sutton, Barlow & Whitaker, 2015 in press).

Species richness estimators estimate the total number of species present in a community. The Chao 1 index is commonly used and is based upon the number of rare classes found in a sample (Chao, 1984): Using the Chao 1 estimator (Colwell & Coddington, 1994), an increment to the numbers observed is derived from the square of the singleton number divided by twice the doubleton number in a series. Applying the Chao 1 estimator to the Whitaker & Kitching Sabah dataset of 14,013 specimens of 2,283 morphospecies of macros and micros (1,681 (6,831 individuals) in primary forest and 1,746 (7,182 individuals) in logged-over forest with 1,144 morphospecies in common) suggests at least 4,285 morphospecies in primary and disturbed forest across northeast Borneo (2,430 in primary forest and 1,962 in logged-over forest). Using the same methodology, Ashton *et al.* (2014) estimate 5,422 macros and micros at Genting (disturbed forest) and 5,097 macros and micros in primary forest at Borneo Rainforest Lodge (Sabah).

### 3. How does diversity change with geographic distances?

#### a) Measuring Beta Diversity; Does 'McDonaldisation' Exist?

At a landscape scale there is often a continuum of habitat change and it is difficult to determine the limits of a particular biotope. Beck & Chey (2003) attempted to address this and other problems of temporal change and altitudinal change using published datasets of geometrid assemblages across 700km in Borneo. They concluded that the variation between the moth ensembles was mainly explained by factors such as elevation, habitat disturbance and temporal factors such as weather and habitat changes over three decades. The validity of their conclusion that residual variation still contains a pattern was tentatively explained by geographical distance, particularly <20km, but methodological differences made their comparison unreliable.

Prof. Roger L. Kitching set out to start to answer the question of β-diversity and its rôle in γ-diversity. This included the statistically robust study on two forest biotopes in Sabah introduced above (Whitaker, 2007, 2008 unpubl.; Whitaker & Kitching, 2008; Kitching *et al.*, 2013). The results showed that there were very similar patterns in moth species richness and levels of diversity in both the primary and logged-over forest. However, a strong relationship was observed between moth assemblages in primary forest, decreasing in similarity with increasing geographic distances over 80km but no such pattern was found in post-logging forest (Figure 1). We speculated that the strong spatial heterogeneity in moth assemblages in the primary forest landscapes may be absent from logged-over forest, through the removal of canopy niche space (Kitching *et al.*, 2013). The small scale spatial heterogeneity in primary forest may be the reason why some α-diversity measurements in primary forest show relatively low values. However, Novotny *et al.* (2007) found a low rate of change in species composition (β-diversity) of many insect groups across lowland primary forest in Papua New Guinea.

Sharp (2014) applied Jost's (2007) 'true' diversity measures with a functionally diverse group (Coleoptera) to estimate ecosystem-level changes in α-diversity, β-diversity and γ-diversity associated with disturbance. Calculating diversity, γ-diversity and β-diversity decreased with disturbance based on taxa richness but not on proportions of taxa counts. In all cases β-diversity was influenced by interactions between distance and disturbance, and provided a more descriptive insight into changing community structure than either other component. Declines in β-diversity are likely to result from reduced habitat heterogeneity and a switch from niche differentiation to habitat filtering (Kitching *et al.*, 2013)

#### 3b) Are Moths Stratified (Ground to Canopy)?

The concept of the tropical forest canopy as a distinct biotope that determines arthropod vertical distribution due to its abiotic factors, forest physiognomy and tree architecture, resource availability and arthropod behaviour, has been proposed for many years. Many workers (e.g. Stork, 1988) postulated that a significant proportion of the biodiversity of primary tropical forests was held in the canopy. The canopies of tropical forests were once thought to contain the most rich and diverse assemblages of insects, and moth abundance was shown to be higher in the forest canopy in Borneo, Papua New Guinea and Panama (Sutton *et al.*, 1983; Kato *et al.*, 1995), although whether this was a real difference cannot be established as identification was not to species so there can be no estimate of species richness or correction for sample size. However, there was growing evidence that the canopy was no more diverse than the

understorey (Hammond, 1990; Wolda *et al.*, 1998; Willott, 1999), though the distributions of insects in woodland appear to be strongly vertically 'compartmentalised' with more or less isolated assemblages of species occupying closely adjacent habitat components within a forest (Basset *et al.*, 1992a; Amedegnato, 2003; Wardhaugh *et. al.,* 2012; Ashton *et al.,* 2015b in prep). Intachat & Holloway (2000) found that there was no consistently significant difference in species richness, abundance or diversity (as measured by α) between the three levels 1, 15 & 30m at Brumas, although values tended to be lower at the highest level. The diversity for the canopy (high) level was significantly lower when all samples were pooled. Here plant diversity is lower and the forest architecture is less complex. Individual flight height preferences varied according to the taxa studied.

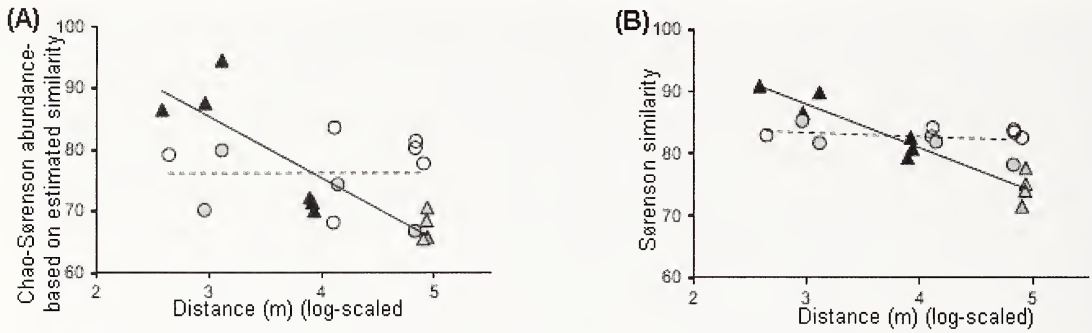


Figure 1.Relationships between geographical distance and (A) Chao-Sørensen & (B) Sørensen similarity values using moth assemblages collected from primary (triangle) and post-logging secondary (circle) forest. Trend lines are drawn for primary forest only.
From Kitching *et al.*, 2012

These comparisons of canopy and understorey faunas in tropical forests are of more than purely theoretical interest. Several papers have examined the extent to which lepidopteran diversity is maintained in disturbed forests or plantations but without samples from the canopy of the primary forest 'control' site (Holloway *et al.*, 1992; Hill *et al.*, 1995; Chey *et al.*, 1997; Holloway, 1998; Hamer *et al.*, 2003). If a large number of canopy specialists are missed in the process then the species richness of the primary forest may be severely underestimated or the taxonomic composition misjudged. Furthermore, there is some evidence that canopy insects may fly closer to the ground in disturbed or plantation forest where the canopy is lower and more open (Davis & Sutton, 1998; Willott, 1999). If these species are detected in ground-based sampling in the disturbed habitat but not the primary, then the estimate of species richness in the former will be inflated relative to that of the latter. Willott (1999), confirmed by Beck *et al.* (2002), showed that there was a substantial turnover of larger moths between the canopy and ground faunas with a combined α-diversity of 367 ± 15, larger than that of its independent components (Table 1).

The same is true of the Pyraloidea: Willott *et al.* (unpubl. ms.) collected a total of 5,322 individual moths comprising 1,207 species on just four nights from April to July 1995. Light traps were sited at Danum Valley Field Station at ground level and at 40m in primary forest canopy. Randomised species accumulation curves for both the macrolepidoptera and Pyraloidea were

generated by randomly sampling without replacement from each dataset to compensate for more species and individuals being collected from the understorey, taking the mean of 1000 iterations for each sample size. Following the same procedure, the mean number of species expected in a sample of 1000 individuals ($S_{1000}$) was generated to provide an estimate of species richness independent of sample size. The data are presented in Table 2.

**Table 2.** Numbers of species (S), individuals (n), diversity (alpha of the log-series) and rarefied species richness ($S_{1000}$) (both mean ± 95% CI). From Willott *et al.* (unpubl.)

| | S | n | Alpha | $S_{1000}$ |
|---|---|---|---|---|
| **Macrolepidoptera** | | | | |
| Canopy | 414 | 1133 | 235 ± 22 | 382 ± 7 |
| Understorey | 500 | 1673 | 242 ± 19 | 375 ± 12 |
| Total | 709 | 2806 | 305 ± 18 | 410 ± 14 |
| **Pyraloidea** | | | | |
| Canopy | 307 | 1084 | 143 ± 14 | 295 ± 6 |
| Understorey | 383 | 1432 | 171 ± 14 | 325 ± 11 |
| Total | 498 | 2516 | 186 ± 12 | 328 ± 13 |
| **Combined** | | | | |
| Canopy | 721 | 2217 | 371 ± 25 | 447 ± 18 |
| Understorey | 883 | 3105 | 412 ± 23 | 471 ± 17 |
| Total | 1207 | 5322 | 487 ± 21 | 487 ± 20 |

A randomised species accumulation curve for the macrolepidoptera was steeper than that for the Pyraloidea, suggesting that a greater proportion of the species pool of Pyraloidea had been sampled. The most abundant macromoth was *Amata prepuncta* Holloway (Erebidae: Arctiinae, Syntomini) with a total of 151 individuals and the most abundant pyraloid was *Pagyda salvalis* Swinhoe (Pyralidae: Spilomelinae) with 102 individuals. In this limited unreplicated study the significant species turnover between the understorey and canopy confirmed that sampling in the canopy is a pre-requisite for an accurate estimate of the diversity and faunal composition of a site. While comprising fewer species, the number of individuals of Pyraloidea approached that of the macromoths in total but the Pyraloidea in Brunei comprised approximately half the total of species and individuals of the micromoths as a whole (Robinson & Tuck, 1993a). This suggests that up to two thirds of the abundance of flying moths may be microlepidopterans. A large proportion of lepidoptera are layer-specialists, with mixing between ground and canopy being the exception rather than the rule (Schulze *et al.*, 2001; Schulze & Fiedler, 2003; Basset *et al.*, 2003; Brehm, 2007). In addition, most are narrowly oligophagous, often being restricted to a single genus or genus-group within a particular plant family while some feed on leaf litter and detritus (Bassett, 1992; Novotny *et al.*, 2002, 2003; Dyer *et al.*, 2007). However, Willott *et al.* (unpubl.) tested groups with >20 individuals in total against the null hypothesis of equal abundance between canopy and understorey in a numerically limited study and showed that the Herminiinae, thought of as leaf litter and detritus feeders, did not conform to that expectation, being found mainly in canopy samples. Possibly this is related to the high biomass of canopy detritus. The families found predominately in the understory were Nolidae: Chloephorinae (Sarrothripini & Chloephorini), Euteliidae (Stictopterinae) and (Pyralidae) Epipaschiinae.

Beck *et al.* (2002) showed that canopy assemblages of geometrids were not very similar to each other and more closely resembled their corresponding understorey samples, a feature noted by Ashton (pers. com., Ashton *et al.*, 2015b in prep.) in Yunnan, China, where different types of forest all showed distinct canopy components to their biodiversity at all sites. Differentiation between samples in the understorey and in the canopy is still a valid concept but may not be universal. Stratification within the canopy itself (which can be >20m thick in Borneo) still remains a mystery and may not exist.

**3c) How does moth diversity change temporally?**

Wolda (1983) considered that seasonal variation of tropical animals was the rule, even where seasonal weather changes are minimal, but definitive studies involving large datasets were lacking. Studies in Sulawesi and Peninsular Malaysia showed slight evidence of temporal heterogeneity (Barlow & Woiwod 1989, 1990). Generally in undisturbed perhumid forests there often seems little difference between samples in successive years (Kitching *et al.*, 2013) but there is usually a significant increase in diversity when the data sets are added (Barlow & Woiwod, 1989; Kitching *et al.,* 2013). A principal component analysis on monthly catches in traps at various levels in primary lowland dipterocarp forest in Sarawak detected non-random seasonal trends of insect abundance (Kato *et al.*, 1995). These could have been due to vegetational succession, phenology or slight seasonal changes during short dry spells (Robinson & Tuck, 1993a,b). Fiedler and Schulze (2004) showed higher temporal variation at primary forest and agricultural sites than in sites with intermediate disturbance. This could be traced down to the species level. That diversity changes over longer periods has been demonstrated on Mt. Kinabalu (Sabah; Borneo) by Chen (2011). This could probably be ascribed to climatological changes (Chen *et al.*, 2009, 2011). A similar long-term change was demonstrated at Genting, West Malaysia, by Ashton *et al.* (2015a in press) using the data sets from 1980-2000 and 2000-2013. This distinct temporal component was possibly associated with vegetational changes.

**3d) How does moth diversity change on altitudinal transects?**

Depending on the geographic location of the tropical forest transect, the position of highest species richness can vary and this is not uniform at smaller taxonomic scales. In many cases this is a result of vegetational changes along the transects - see Axmacher & Fiedler (2008) on Mt Kilimanjaro. α-diversity of Geometridae, Pyraloidea and Arctiidae significantly declined in Ecuador between 1,040m and 2,677m a.s.l., but was overall remarkably high: 250.1, 185.1, and 96.1 respectively (combined α-diversity of 531.6) and α was 120-185 even at the highest sites. The Geometroidea maintained their diversity to the highest levels whereas most of the Pyraloidea showed the expected decline of ectothermic herbivores from α 100 at 1,040m to <35 above 2,000m while the Arctiidae showed a much less steep decline, similar to the Crambidae as compared with the Pyraustinae (Brehm *et al.*, 2003; Fiedler *et al.*, 2008).

Maximum diversity for macromoths in Borneo was noted around 1,000m a.s.l. (Holloway, 1987; Holloway *et al.*, 1990; Chey, 2000). These differences may relate to vegetational richness of food plants (Holloway & Nielsen, 1999; Beck *et al.,* 2002) or to moth clade tolerance of lower temperature regimes (Fiedler *et al.*, 2008). On Mt Kinabalu maximum vegetational richness is around 1,000-1,299m (Ashton, 2003).

The Queensland-Chinese Academy of Sciences project (Q-CAS) was born to test these ecological concepts on an ever greater scale across the length of Yunnan Province from the south-western lowland tropical forests at Mengla through mid-altitude subtropical and deciduous forests of Aila Shan to the alpine coniferous forests near Lijiang on the borders of Tibet. It involved replicated sampling of canopy and ground. The enormous dataset of botanical and entomological samples from replicated altitudinal transects between 800m and 3,800m is still being worked on (Ashton *et al.*, 2015b in prep.).

**3e) How does moth diversity change on latitudinal transects within forest biotopes?**

There are two current models of community assembly based on one hand on ideas of neutral species replacement and on the other of resource-based niche partitioning. Niche dimensions can be determined by two non-overlapping sets of physico-chemical parameters (or their surrogates: altitude, latitude or substrate) and the physiologically defined envelope in which an organism can exist. Kitching (2013) examined the geographic scale of when wholly stochastic processes give way to deterministic processes (the stochastic-deterministic switch line (SDL)) and concluded that there is a point for each class of ecological community at which an assembly cannot be distinguished from a random combination of species. This model explains the distance-decay change observed in primary forest moth communities over 80km first elucidated in Sabah and its absence in logged-over forest (Kitching *et al.*, 2013). Kitching (2013) considered that the associated changes in moth assemblages are driven by locally changing availability of larval food plants. The underlying vegetation changes can usually be explained by neutral ideas over a scale of several hundred kilometres as modified to include dispersal distances. The biogeography of lowland forest moths in Malaysia over several hundred kilometres (Ashton *et al.*, 2015a in press) can probably be explained by a combination of niche suitability and random (stochastic) dispersal plus colonisation and speciation events.

The Q-CAS Project with its large collections of several invertebrate groups will undoubtedly add to our knowledge of these processes. Combined moth collections (macromoths and pyralids, determined as morphospecies) from each of the three Q-CAS altitudinal transects showed the following approximate numbers; 2,500 from Mengla (800-1400m); 1,600 from Ailoa Shan (2000-2700m) and 750 from Lijiang (Mt Satseto) (3200-3800m). At Mengla it is probable that Lepidopteran diversity is extremely high, higher than any measured in the Malaysian Peninsular and probably approaching those of Borneo (Ashton *et al.*, 2015a in press).

**3f) How do patterns of moth diversity change between continents?**

Ashton *et al.* (2015a in press), working on 64 data sets from China (Yunnan), Panama, Vietnam, Borneo and Papua New Guinea (containing 175,768 moths) showed consistent differences between canopy and ground assemblages at almost all rainforest locations and across altitudinal and latitudinal gradients. Vertical beta diversity increases with increasing elevation in each of the northern hemisphere transects that have been undertaken. This is a reverse (and unexpected) pattern compared to that in the southern hemisphere. This is possibly related to structural differences in vegetation patterns.

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# Nine years of change in the flora of Ellerburn Bank, a limestone grassland in the North York Moors

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## Introduction

Limestone grassland is one of the most biodiverse habitats on Earth at a small scale (Wilson *et al.*, 2012). Floristic richness within Europe can reach 80 species per $m^2$ (Butaye *et al.*, 2005) and many plants are found in no other habitat. Limestone grassland also supports important invertebrate communities as well as specialist birds (UK Steering Group, 1998). However, it is also one of Europe's most threatened habitats (WallisDeVries *et al.*, 2002). In 1998 there was a maximum of 41,000 hectares of lowland calcareous grassland remaining in the UK (UK Steering Group, *loc. cit.*). Loss of habitat continues from forestry, conversion of pastureland to crops and land abandonment (WallisDeVries *et al., loc. cit.*), leading to reductions in the area and increases

in the isolation of habitat patches (Fisher & Stöcklin, 1997). Quality reductions come from the abandonment of traditional agricultural practices leading to land-use intensification such as increased fertilization, herbicides, reseeding and frequent or early mowing (WallisDeVries *et al.*, *loc. cit.*). They may also result from overgrazing, undergrazing leading to the encroachment of scrub, Bracken *Pteridium aquilinum* and coarse grasses (Bobbink & Willems, 1987), and atmospheric nitrogen deposition leading to loss of richness (van den Berg *et al.,* 2011). The latter threats mean that their quality may decline even if sites are enclosed in protected areas, due to pervasive forces beyond the control of reserve managers (van den Berg *et al., loc. cit.*) or as a consequence of suboptimal management. Indeed, JNCC declared that only 29% of Sites of Special Scientific Interest (SSSI) and 27% of Special Areas of Conservation (SAC) on lowland calcareous grassland in the UK were in favourable condition in 2006, below the average for habitats in general (Williams, 2006). Optimal management is difficult to achieve because the effects of different practices can vary depending on local conditions (Klimek *et al.*, 2007) and the taxonomic group under consideration (WallisDeVries *et al., loc. cit.*).

Ellerburn Bank is a 2.91ha grassland site sloping south-east on oolitic limestone on the southern edge of the North York Moors near Pickering (SE853849: VC62). Despite its modest size, it is one of the most extensive areas of unimproved limestone grassland remaining in the North York Moors (Sykes, 1993). It was notified as a SSSI in 1983 and has been managed as a nature reserve by the Yorkshire Wildlife Trust (YWT) since 1966, having been informally managed for nature conservation perhaps for the previous decade (Yorkshire Wildlife Trust, 2012). The flora and fauna of the site is exceptional for the region, with over 150 species of plant recorded (Sykes, *loc. cit.*) including large displays of Cowslip *Primula veris* in spring, orchids in early summer (Plate 1, centre pages) and Felwort *Gentianella amarella* in late summer (Leadley & Richards, 2012). Flowering plants of regional note include Dropwort *Filipendula vulgaris*, Woolly Thistle *Cirsium eriophorum,* Saw-wort *Serratula tinctoria*, Fly Orchid *Ophrys insectifera* and Greater Butterfly Orchid *Platanthera chlorantha*. The site is noted for its extensive Lepidoptera fauna (Frost, 2005), including butterflies of regional note such as Dark Green Fritillary *Argynnis aglaja* and Dingy Skipper *Erynnis tages*, and the site also supports a population of Glow-worm *Lampyris noctiluca*. Management of the reserve currently consists of low-intensity winter grazing by Hebridean sheep (Leadley & Richards, *loc. cit.*) and rotational scrub clearance (often burnt on site). The site is listed as in 100% favourable condition by Natural England (2014) and light winter grazing is its official management advice (English Nature, 2004). The upper, north-western margin borders an agricultural field and consists of a Bronze Age earthwork (a double ditch and bank) partially covered with Hawthorn *Crataegus monogyna* and Blackthorn *Prunus spinosa* scrub, whilst the lower, south-eastern side bordered by forestry, consists of a patchwork of taller grass and Gorse *Ulex europaeus* scrub (Fig. 1, Plate 1c, centre pages).

From 1999 to 2011, with the exception of 2001 due to the Foot-and-Mouth disease epidemic, the bank and surrounding areas of Dalby Forest were visited in the first week of July as part of the second year Ecology Field Course run by the Department of Biology at the University of York. In the early years of this field course it was noticed that one of the taller grasses, False Brome *Brachypodium sylvaticum*, common around the scrubby fringes of the reserve, also occupied large visible patches across the central and south-eastern parts of the pasture where colonization of young woody scrub plants was noticeable (see Plates I(b), I(c) and I(d), centre pages). It was decided to attempt to monitor the spread of False Brome and woody scrub as well

as their potential effects on the other flora from year to year. 24 permanent $1m^2$ quadrats (Fig 1) were sited throughout an area where small woody scrub plants and False Brome were noticeable in 2003, from which time they were systematically surveyed for flowering plants. The quadrats were re-surveyed in five of the nine years subsequent to that (2004, 2005, 2008, 2009, 2011). Changes to the structure of the degree programme at York in 2012 necessitated running the field course earlier in the year, in May and then June. Although the quadrats were surveyed in 2012 and 2013, the different survey dates make the data less comparable with those from previous years because of the different apparency of above-ground parts of the plants used for identification. It therefore seems timely to summarize here some of the findings from the initial years of survey work.

During or just prior to the years of study reported here, the following management on the reserve was carried out (Yorkshire Wildlife Trust, *loc. cit.*): in February 1999, a strip of Gorse adjacent to the south-eastern boundary of the reserve, extending south-west from quadrats 5 and 6 (Fig. 1), was removed by British Trust for Conservation Volunteers. In November 1999, an area of Gorse on the south-eastern boundary of the Reserve, close to quadrats 18 and 22, was probably removed by contractors. Other small areas of scrub on the earthwork and Gorse further south from the study quadrats were removed in 1999. In October 2001, because of absence of grazing due to the Foot-and-Mouth epidemic, a strip of long grass along the north-eastern and south-eastern boundaries of the reserve was mown. This may have encroached over quadrats 5, 9, 10, 13, 18 and 22. In 2003 an area of Hawthorn saplings immediately to the north of quadrats 15, 20, 23, and 24 was removed by strimming. In January 2007 a small area of scrub on the earthwork was cleared by a National Park volunteer group. In October 2007 YWT staff cut and treated an area of Gorse to the north-east of the study quadrat area but also in the vicinity of quadrats 17, 18, 21-24. In January/February 2008 the Hobs volunteer group also cut and burnt an extensive area of scrub along the earthwork and Gorse close to quadrats 5, 6, 9 and 10. Bracken was cleared along the north-eastern reserve boundary in 1998 and 2008.

From 1998 to 2004 a creep grazing regime was used, which saw 21 sheep being grazed progressively on three enclosed paddocks on the centre of the pasture, from south-west to north-east, the last of which covered the area of the study quadrats, for around 18 days on each during the winter period. An extra paddock was grazed in 1999 extending grazing north-east. In 2003 grazing pressure was increased from 21 sheep to 40 sheep which grazed the four successive pastures, still in a creep grazing routine. From 2005-2010 a continuous winter grazing regime was used. Approximately 30 Hebridean sheep were located on the site between October and March. Overall then, annual grazing was the main management activity immediately affecting the quadrated area, though some scrub removal took place immediately adjacent to the quadrated area, and over the north-eastern part of it in October 2007.

In this article we first summarize the community of flowering plants found in the permanent quadrats. We then test four hypotheses of vegetation change related to the efficacy of management of calcareous grassland sites which motivated the work: that False Brome is increasing in frequency in the sampled area; that woody scrub plants are increasing in frequency in the sampled area; that richness and alpha diversity are decreasing over time; and that the Ellenberg indicator nitrogen scores (Hill *et al.*, 1999) are increasing over time.

**Methods**

Twenty-four permanent $1m^2$ quadrats were sited across an area of the central and south-eastern parts of the pasture measuring 120m x 40m using a stratified random design (Fig 1, Appendix 1). The total area was divided into twelve 20m x 20m units and two $1m^2$ quadrats were randomly sited in each. The corners of each $1m^2$ quadrat were marked by six inch steel nails hammered into the ground. In subsequent years the quadrats were relocated by metal detector, aided in later years by the use of a hand-held GPS receiver.

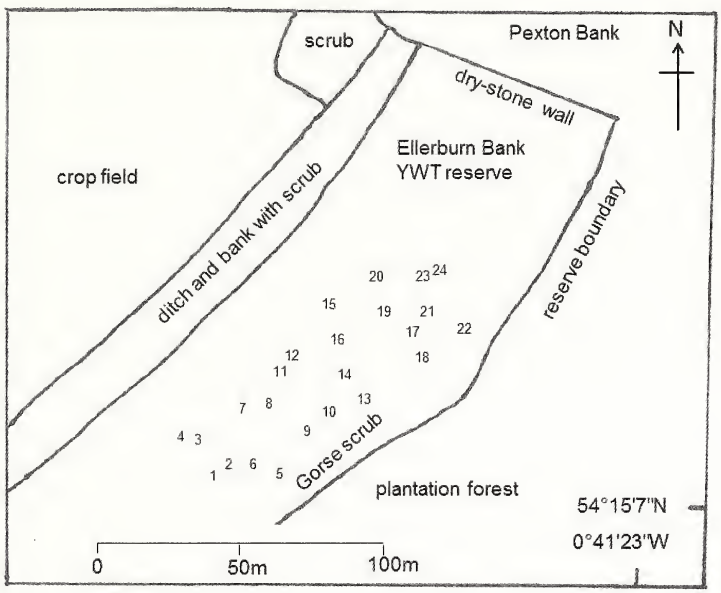


Figure 1: Map of the northern part of Ellerburn Bank showing the location of the survey quadrats and local surroundings.

Plants were recorded using a semi-quantitative method. A gridded quadrat consisting of 25 divisions of 20cm x 20cm was placed over each $1m^2$ location. Presence/absence of each plant species was recorded in each of these sub-units of the quadrat and the number of these subunits totalled to give an occupancy score between 0 and 25, representing how widely that plant occurred in each quadrat. This method allowed year-to-year consistency and is relatively rapid, given that surveying had to be completed in 2-3 days each year and by different students in each year. Leaf shape was generally sufficient to allow accurate identification for the herbs but presence of a grass was only recorded if a flowering stem was present, allowing accurate identification. The exceptions were Cock's-foot *Dactylis glomerata,* whose fleshy leaves are distinctive, and False Brome, whose wide tough and yellow leaves are also distinctive. One grass, Creeping Bent *Agrostis stolonifera*, was also initially identified by leaf alone but subsequent observations cast doubt on the efficacy of this identification and only flowering stems were used in subsequent years. However, because of this inconsistency, this plant is eliminated from the analyses below requiring occupancy estimates. Mosses were not recorded.

Two teams of two students conducted the surveying each year. This arrangement facilitated speedy recording and allowed students to consult each other in case of doubt. Each team was armed with a flower guide (Fitter *et al.*, 1996) and a grass guide (Fitter *et al.*, 1984), along with the species list from previous years' surveying. In addition, each team received close tuition on plant identification during their first quadrats from the first author, who revisited them at approximately hourly intervals during surveying to handle identification queries. All students had previously participated in a class quadrating practical on the bank as part of the field course, giving them some experience with plant identification. Despite this effort to minimize identification errors, some students found it difficult to distinguish some plants by leaf shape, particularly Common Knapweed *Centaurea nigra* and Field Scabious *Knautia arvensis*, which can have quite similar leaves to the inexperienced eye. Year-to-year fluctuation in occupancy may, therefore, to some extent reflect year-to-year variability in identification error. However, consistent temporal trends are still likely to represent real changes in the plant community.

The community composition of all plants within quadrats was explored graphically using Non-metric Multidimensional Scaling (NMDS), implemented using the metaMDS function in the vegan package in R (R Core Team, 2014). NMDS is an ordination analysis in which differences in community composition are summarized in a small number of dimensions (normally two) for ease of visualization. Species and quadrats close together in a plot of the NMDS axes show closer associations in occupancy across quadrats. Occupancy data were $\log_{10}(x+1)$ transformed prior to analysis.

To identify if woody scrub plants and False Brome were associated with particular plant communities, the herb and grass occupancies within quadrats were subjected to Detrended Correspondence Analysis (DCA), another ordination analysis, using the decorana function in the vegan package in R. The analysed data omitted False Brome and woody scrub plants and were $\log_{10}(x+1)$ transformed prior to analysis, with rare species downweighted. The extracted axis scores for each quadrat were correlated against the mean occupancy of Hawthorn and False Brome within quadrats, as a statistical test of association between those species and the community of other plants.

Temporal changes in the occupancy of False Brome, of woody scrub plants, richness and alpha diversity and of the occupancy-weighted Ellenberg indicator nitrogen scores (Hill *et al.*, *loc. cit.*) were analysed by linear mixed effect models with repeated measures, with quadrat coded as a fixed factor repeat-measured across year, and with year as a covariate. Analysis was conducted in SPSS v.21. Alpha diversity was scored using Simpson's index on the occupancy data, which is recommended for small sample sizes (Magurran, 2004), using the inverse index $1/D$, where larger values indicate a more even community, in which species have more similar occupancies to each other; Ellenberg nitrogen scores for flora scale from 1 (extremely infertile) to 9 (extremely fertile) (Hill *et al. loc. cit.*).

## Results

### The plant community

A total of 62 species (Appendix 2) was recorded over the six survey years, comprising 42 forbs (of which 6 were legumes), 12 grasses, 1 sedge and 7 woody scrub plants. A rank occupancy chart (omitting Creeping Bent) (Fig 2) shows that the most common twelve plants account for

79% of the average occupancy and that other plants have very low occupancy. These twelve were, in decreasing rank occupancy order, Common Bird's-foot-trefoil *Lotus corniculatus*, Glaucous Sedge *Carex flacca*, Salad Burnet *Sanguisorba minor*, Field Scabious, Rough Hawkbit *Leontodon hispidus*, Quaking Grass *Briza media*, Cock's-foot, Common Knapweed, Upright Brome *Bromopsis erecta*, Lady's Bedstraw *Galium verum*, Red Clover *Trifolium pratense*, False Brome, Fairy flax *Linum catharticum*, Ribwort Plantain *Plantago lanceolata* and Yellow Oat-grass *Trisetum flavescens*. Several of these are central to the entomological interest of the site, with Common Bird's-foot-trefoil and Red Clover supporting Common Blue Butterfly *Polyommatus icarus*, Six-spotted Burnet *Zygaena filipendulae,* Narrow-bordered Five-spotted Burnet *Z. lonicerae*, Burnet Companion *Euclidia glyphica* and Dingy Skipper. Cock's-foot and False Brome are favoured foodplants of many grass-feeding butterflies, including Small Skipper *Thymelicus sylvestris*. Other recorded plants included Hairy Violet *Viola hirta*, which supports Dark Green Fritillary, and Common Rock-rose *Helianthemum nummularium,* which supports Brown Argus *Aricia agestis*, whilst in the recent past Cowslip has held populations of Duke of Burgundy *Hamearis lucina* and Milkwort *Polygala vulgaris* supported Small Purple-barred *Phytometra viridaria* (Sutton & Beaumont, 1989). The woody scrub plants were, in order of decreasing rank occupancy: Hawthorn, Dog Rose *Rosa canina*, Gorse, brambles *Rubus fruticosus* agg, Pedunculate Oak *Quercus robur*, Blackthorn and Scots Pine *Pinus sylvestris*. Other plants of note for their vivid floral displays include Common Spotted Orchid *Dactylorrhiza fuchsii* (see Plate I (a), centre pages) and Felwort; and the regionally scarce Dropwort, Fly Orchid (see front cover) and Woolly Thistle.

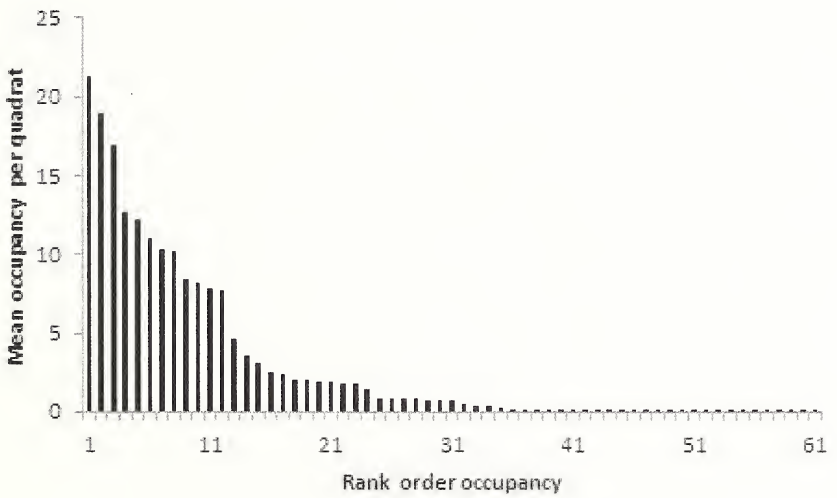


Figure 2: Rank occupancy plot of the plant species recorded. Precise occupancy values, with standard errors, are given in Appendix 2.

An ordination of quadrats using NMDS shows close associations between the twelve most ubiquitous plants, as expected (Fig 3b): those with low scores on the first axis (Fig 3a) include Sweet Vernal Grass *Anthoxanthum odoratum* (code F), Yorkshire Fog *Holcus lanatus* (code b), Gorse (code Gg) and Wild Strawberry *Fragaria vesca* (code W), along with three occasionals: Chickweed *Stellaria media* (code z), Woolly Thistle (code O) and Bearded Couch Grass *Elymus caninus* (code S), whilst on the opposite end of the first axis lie Rockrose (code Z), Meadow

Buttercup *Rananculus acris* (code u) and Blackthorn (code s), which tended not to be associated with the former group. On the second axis, the lowest scores come from the same three occasionals plus Hogweed *Heracleum sphondilium* (code a) and Dog Rose (code v). At the opposite end of this axis are Sweet Vernal Grass (code F), Bramble (code w), and Sweet Violet *Viola odorata* (Jj). The scrub plants (e.g. Pedunculate Oak, code t), with the exception of Hawthorn (code P), tend to occur on the fringes of the core set. False Brome (code H) has a slightly negative score on both axes and is most closely associated with Hogweed (code a), eyebrights *Euphrasia officinalis* s.l. (code T) and Meadow Vetchling *Lathyrus pratensis* (code e) within the core community. Plants not associated with False Brome include Wild Thyme *Thymus polytrichus*, Harebell *Campanula rotundifolia*, Common Rock-rose and Felwort. Common Spotted Orchid (code R) is associated with Goatsbeard *Tragopogon pratensis* (code Cc), Upright Brome *Bromopsis erecta* (code J), and Quaking grass (code I).

A plot of the first two DCA axes (scrub plants and False Brome not included) (Figure 4) shows similar sets of species associations. The mean occupancy of False Brome within a quadrat was significantly positively correlated with the DCA1 score for that quadrat ($r_s$ = 0.44, $n$ = 24, $P$ = 0.03) but not any of the other DCA axis scores. The mean occupancy of Hawthorn within a quadrat was significantly positively correlated with the DCA2 score for that quadrat ($r_s$ = 0.47, $n$ = 24, $P$ = 0.02) but not with any of the other DCA axis scores.

Figure 3. Non-metric Multidimensional Scaling (NMDS) plots of the plant communities sampled.

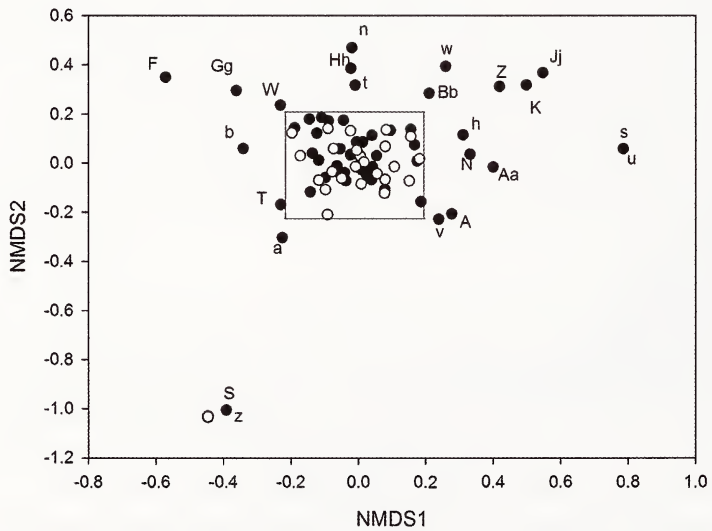


Figure 3a. Species (letter codes identified in Appendix 2) are filled circles and quadrats are open circles. The central box is the area plotted below.

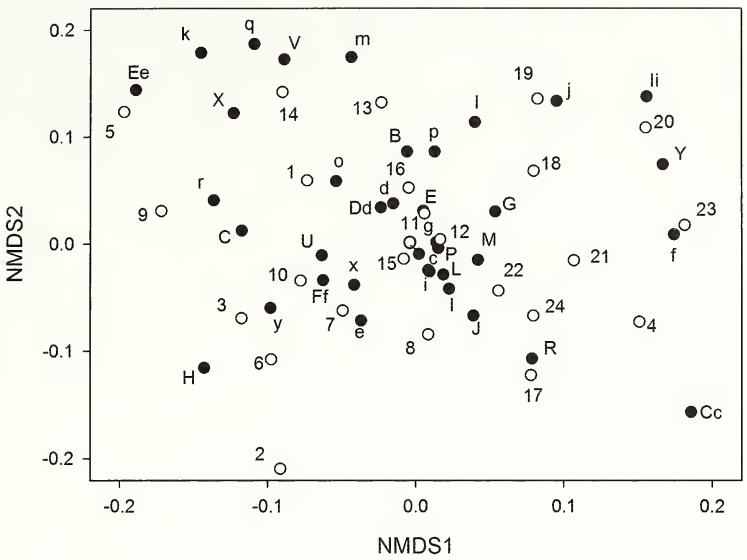


Figure 3b. The centre of the plot denoted by the box in Fig. 3a at a finer axis scale, with quadrats also identified by number used in Fig.1 and Appendix 1, and species identified by letter codes in Appendix 2.

Figure 4: Detrended Correspondence Analysis plot of the plant communities sampled, showing axes 1 and 2.

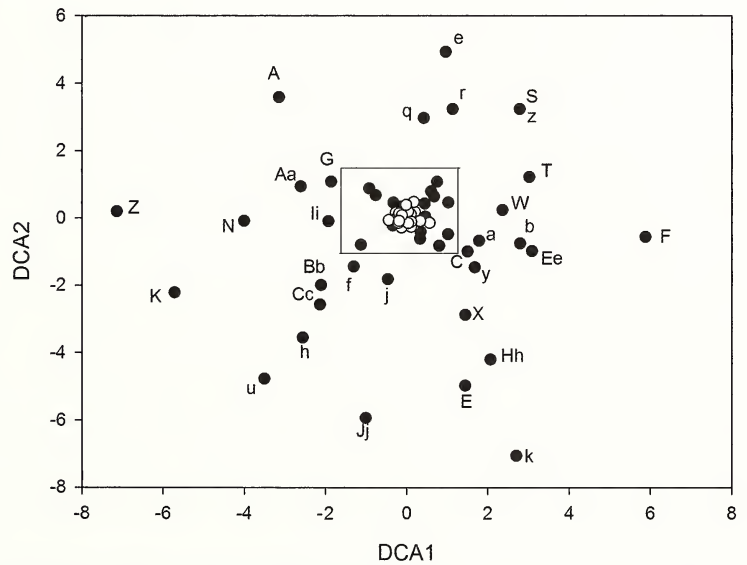


Figure 4a. Species letter codes identified in Appendix 2 are filled circles and quadrats are open circles. The central box is the area plotted below.

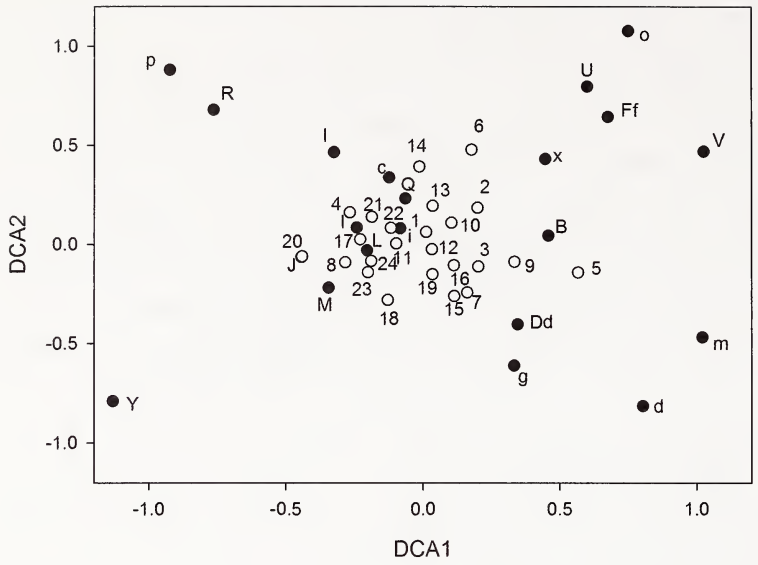


Figure 4b. The centre of the plot denoted by the box in Fig. 4a at a finer axis scale, with quadrats also identified by number used in Fig. 1 and Appendix 1, and species identified by letter codes in Appendix 2.

Changes through time

The 1m$^2$ quadrats varied in mean plant species richness from 16 to 23, with the lowest value in any year being 14 and highest 28, a two-fold difference (Appendix 3). A linear mixed effects model showed that richness per quadrat significantly increased slightly over time at a rate of about 0.2 species per year ($F$ = 10.2, df = 1,36, $P$ = 0.003) and differed amongst quadrats ($F$ = 5.21, df = 23, 36, $P$ < 0.001). Richness was not correlated with the occupancy of False Brome ($r_s$ = -0.202, $n$ = 24, $P$ = 0.345) nor with the commonest scrub plant: Hawthorn ($r_s$ = 0.387, $n$ = 24, $P$ = 0.062).

Simpson's diversity (1/$D$), calculated on occupancy within 1m$^2$ quadrats, varied from an average of 9.9 to 15.0 with the highest value in any year being 18.1 and lowest value 6.5 (Appendix 3), a nearly three-fold difference. A linear mixed effects model showed that diversity per quadrat increased slightly but significantly over time at a rate of about 0.2 units per year ($F$ =22.68, df = 1,33, $P$ < 0.001) and differed amongst quadrats ($F$ = 6.31, df = 23, 11, $P$ = 0.002). Simpson's index was not significantly correlated with either False Brome occupancy ($r_s$ = -0.053, $n$ = 24, $P$ = 0.806) or the occupancy of the commonest scrub species (Hawthorn) ($r_s$ = 0.173, $n$ = 24, $P$ = 0.418).

Weighted average Ellenberg nitrogen scores per quadrat varied from 3.1 to 3.6 across quadrats, with the highest annual figure being 3.9 and lowest 2.9 (Appendix 3). A linear mixed effects model showed a small but significant decline (0.01 units per year) in average nitrogen scores over time ($F$ = 4.22, df = 1, 54, $P$ = 0.045) and a significant difference between quadrats ($F$ = 9.27, df = 23, 85, $p$ < 0.001).

Quadrats varied considerably in their occupancy by False Brome, from zero in all years in one quadrat to a mean of over 21 in another, with 25 reached in at least one year by four quadrats (Appendix 3). A linear mixed effects model shows no significant effect of year on False Brome occupancy ($F$ = 0.341, df = 1, 68, $P$ = 0.561), though occupancy differed between quadrats ($F$ = 27.5, df = 23, 92, $P$ < 0.001). This suggests that the quantity of False Brome shows no overall trend from year to year, though it differs from place to place.

Quadrats varied in their woody scrub species occupancy from zero in all years in two quadrats to a highest average of 11.5, with the highest value reached in a single year being 20 (Appendix 3). Occupancies were square root transformed prior to analysis to normalize the variance. There was no significant effect of year on scrub species occupancy ($F$ = 2.803, df = 1, 64, $P$ = 0.099) but occupancy differed between quadrats ($F$ = 12.1, df = 23, 110, $P$ < 0.001). This suggests that the quantity of scrub shows no overall trend from year to year, though it differs from place to place.

**Discussion**

The data presented here do not suggest that False Brome or woody scrub plants have noticeably increased across the sampled area of Ellerburn Bank over the period investigated, but both groups of plants are well represented in the quadrats. The spread of woody scrub through succession to a woodland climax (Tansley, 1922) is a well-known reason for the loss, and reduction in quality, of calcareous grassland in Europe and requires careful management (Butuye *et al.*, *loc. cit.*). At Ellerburn Bank, two interventions are taken to reduce scrub invasion: winter grazing by sheep (Leadley & Richards, *loc. cit.;* YWT, *loc. cit.*) and less frequent cutting by hand. In addition, grazing by wild vertebrates such as deer and Rabbits *Oryctolagus cuniculus* occurs. The optimal level of scrub removal is hard to gauge. At Ellerburn Bank, the central area of pasture, including the area covered by the quadrats, is intended to be maintained as calcareous grassland, leaving scrub to the fringes of the reserve. Hence, it would probably be preferred if there were no scrub at all over the quadrated area. The fact that scrub maintains a noticeable and constant presence indicates that the current level of grazing should not be lowered in future, otherwise one could expect scrub to encroach more rapidly over the pasture, necessitating further targeted cutting activity in order to maintain the quantity of grassland. Higher levels of grazing may help reduce the problem of scrub encroachment from the fringes, but may harm flora less tolerant of grazing or trampling. The scrub around the fringes is tolerated as it provides wind shelter and a mosaic of taller vegetation, adding structural and biological diversity to the site that is necessary for many of the grassland invertebrates. Although the management plan (YWT, *loc. cit.*) calls for annual removal of parcels of scrub from the earthwork and south-eastern boundary, in practice such interventions have been less frequent, perhaps meaning that sources of scrub seeds that can encroach over the meadow are more numerous than would be ideal, and that the shorter-growth regenerating areas are actually encroaching onto the pasture rather than remaining around the fringes of the reserve.

One of the possible negative consequences of limited scrub invasion is that it facilitates the spread of coarse grasses, such as False Brome. This was one of the plants found to have significantly increased in calcareous grasslands in Dorset in recent decades (Newton *et al.*, 2011). Despite being abundant in our quadrats, this study provides no evidence for a recent increase on Ellerburn Bank. Nine years is a relatively short timescale compared to the timescale

of decades on which Newton's study was based, and yet the data solidly reject any rapid increase but suggest that once established, False Brome does not inevitably continue to spread.

False Brome occupancy was significantly correlated with the first DCA axis (Fig. 4) whilst Hawthorn was significantly correlated with the second. This suggests that both are non-randomly distributed in relation to the other plants in the community. Non-random associations in space could be caused by a number of different factors, including proximity to a seed or vegetative growth source, establishment success and competitive exclusion of other plants. Since these studies were observational rather than experimental, it is difficult to distinguish these different possibilities, although competitive exclusion of stress-tolerating plants by competitors would be expected (Newton *et al.*, *loc. cit.*). NMDS (Fig. 3) suggests that False Brome tends not to be associated with several low-growing stress-tolerators such as Wild Thyme, Harebell, Common Rock-rose, Felwort and Rough Hawkbit but that it is more associated with Hogweed, Meadow Vetchling, Eyebright and Yellow Oat-grass. Whatever the causes of these associations, these data do suggest that potential winners and losers were the frequency of False Brome to either increase or decrease further, and they also suggest what is added and lost through allowing a certain quantity of False Brome to establish on site. Given that False Brome persists anyway around the scrubby fringes of the reserve, there is an argument for increasing the intensity of grazing and scrub removal to avoid further establishment of False Brome across the grassland at the expense of the shorter stress-tolerators.

Apart from scrub invasion, one further reason to expect increases in False Brome frequency is the deposition of atmospheric nitrogen leading to eutrophication (Newton *et al.*, *loc. cit.*, van den Berg *et al.*, *loc. cit.*). Sampling from across the UK has shown that nitrogen deposition significantly predicts reductions in floral diversity and evenness and the absence of rare plants. Being on the North York Moors, Ellerburn Bank is expected to receive a high nitrogen deposition load, estimated at 20.4 $kgha^{-1}yr^{-1}$ in 2008 (data from the Centre for Ecology and Hydrology in van den Berg *et al.*, *loc. cit.*). This is within the range of critical loads for adverse effects on calcareous grassland based on field experiments (Bobbink *et al.*, 2010). Comparisons of two long term quadrats on the bank between 1990 and 2008 showed a slight increase in Shannon diversity, a slight decrease in evenness and a slight reduction in richness (data from van den Berg *et al.*, *loc. cit.,* courtesy of Leon van den Berg). The majority of managed sites in the UK with a similar nitrogen load actually increased in richness and evenness over the same time period, whilst several decreased (van den Berg *et al.*, *loc. cit.*, their Fig. 3), and those that increased tended to have a higher soil pH. In addition, those that experienced an increase in grazing pressure tended to experience reductions in their average Ellenberg nitrogen index. Ellerburn Bank is sited on shallow, free-draining alkaline soil and experienced an estimated increase in grazing pressure between 1990 and 2008 of approximately four times (data from van den Berg *et al.*, *loc. cit.*). Grazing is likely to be the chief intervention responsible for the (slight) downward trajectory of the Ellenberg nitrogen scores shown in the present study, and this adds to the above arguments for at least maintaining the current level of grazing pressure. If, as expected, nitrogen deposition remains a problem in the future, grazing should probably be increased to compensate.

Part of the interest in maintaining the flora of the reserve is the conservation of the invertebrate community that depends on it. The butterflies have received most attention in this regard; a

monitoring transect begun in 2010 (YWT, *loc. cit.*) showed that the most abundant species were Small White *Pieris rapae,* Green-veined White *Pieris napi* (ubiquitous species not relying on the calcareous grassland but visiting flowers such as Knapweeds and Scabious), Meadow Brown *Maniola jurtina* and Small Heath *Coenonympha pamphilus* (both grass feeders). Small Skipper is another common grass-feeder. Dingy Skipper and Common Blue are other abundant butterflies, and both rely on the Common Bird's-foot-Trefoil which our quadrats show to be one of the most abundant plants in the calcareous grassland. Common Rock-rose (supporting Brown Argus), Milkwort (supporting Small Purple-barred moth), and violets (supporting Dark Green Fritillary) are frequent but less dominant components of the community; both Common Rock-rose and violets are more common on the earthwork than in the area of our quadrats but management needs to take account of them given that these butterflies are less common on site and regionally. Should the Duke of Burgundy ever return to the vicinity, it will still find abundant Cowslips.

Taken together, our results suggest that current management of the calcareous grassland at Ellerburn Bank is currently sufficient to offset the deleterious effects of atmospheric nitrogen deposition, but a significant presence of woody scrub and False Brome persists, which is probably undesirable away from the reserve fringes. There is a case for more frequent scrub removal at the reserve fringes and increased grazing pressure on the grassland to prevent further encroachment of scrub and the effects of atmospheric nitrogen deposition. Intermittent monitoring will be necessary in future to gauge whether the current situation continues. To facilitate this, we have provided details of the permanent quadrat locations in Appendix 1, a summary of the species' occupancies from our survey in Appendix 2, and the average properties of the quadrats in Appendix 3. Future monitoring work could also specifically target the plant species of regional note (such as Fly Orchid and Woolly Thistle) which were not best surveyed using the present methods, but which should feature highly in management priorities.

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**Appendix 1**. Locations of permanent quadrats on Ellerburn Bank. Quadrat number refers to identities on the map in Fig. 1 and in Fig. 3b.

| Quadrat Number | Latitude | Longitude |
|---|---|---|
| 1 | 54°15'8.30"N | 0°41'34.25"W |
| 2 | 54°15'8.53"N | 0°41'33.76"W |
| 3 | 54°15'8.70"N | 0°41'34.50"W |
| 4 | 54°15'8.78"N | 0°41'34.81"W |
| 5 | 54°15'8.50"N | 0°41'33.05"W |
| 6 | 54°15'8.68"N | 0°41'33.44"W |
| 7 | 54°15'9.28"N | 0°41'33.69"W |
| 8 | 54°15'9.35"N | 0°41'33.17"W |
| 9 | 54°15'9.04"N | 0°41'32.39"W |
| 10 | 54°15'9.23"N | 0°41'32.07"W |
| 11 | 54°15'9.71"N | 0°41'33.27"W |
| 12 | 54°15'9.97"N | 0°41'33.11"W |
| 13 | 54°15'9.75"N | 0°41'31.72"W |
| 14 | 54°15'9.46"N | 0°41'31.37"W |
| 15 | 54°15'10.66"N | 0°41'32.14"W |
| 16 | 54°15'10.05"N | 0°41'32.01"W |
| 17 | 54°15'10.52"N | 0°41'30.57"W |
| 18 | 54°15'10.24"N | 0°41'30.44"W |
| 19 | 54°15'10.50"N | 0°41'31.39"W |
| 20 | 54°15'10.97"N | 0°41'31.55"W |
| 21 | 54°15'10.75"N | 0°41'30.34"W |
| 22 | 54°15'10.65"N | 0°41'29.59"W |
| 23 | 54°15'10.93"N | 0°41'30.82"W |
| 24 | 54°15'10.97"N | 0°41'30.53"W |

**Appendix 2.** Complete plant list and mean (SE) occupancy (out of 25) per quadrat. Species are assigned a letter code identifying them in the ordination plots (Figures 3 & 4).

| Species (code) | Mean Occupancy (SE) | Species (code) | Mean occupancy (SE) | Species (code) | Mean occupancy (SE) |
|---|---|---|---|---|---|
| *Achillea millefolium* (A) | 0.06(0.06) | *Filipendula vulgaris* (V) | 0.77(0.34) | *Primula veris* (q) | 1.95(0.65) |
| *Agrimonia eupatoria* (B) | 2.56(0.45) | *Fragaria vesca* (W) | 0.70(0.25) | *Prunella vulgaris* (r) | 0.88(0.23) |
| *Agrostis capillarum* (C) | 0.06(0.03) | *Galium verum* (X) | 8.17(1.78) | *Prunus spinosa* (s) | 0.01(0.01) |
| *Agrostis stolonifera* (D) | N/A | *Gentianella amarella* (Y) | 0.87(0.20) | *Quercus robur* (t) | 0.03(0.02) |
| *Anacamptis pyramidalis* (E) | 0.02(0.01) | *Helianthemum nummularium* (Z) | 0.08(0.06) | *Ranunculus acris* (u) | 0.01(0.01) |
| *Anthoxanthum odoratum* (F) | 0.03(0.03) | *Heracleum sphondylium* (a) | 0.56(0.24) | *Rosa canina* (v) | 0.20(0.13) |

| | | | | | |
|---|---|---|---|---|---|
| *Anthyllis vulneraria* (G) | 1.76(0.52) | *Holcus lanatus* (b) | 0.74(0.25) | *Rubus fruticosus* agg. (w) | 0.06(0.04) |
| *Brachypodium sylvaticum* (H) | 7.76(1.45) | *Knautia arvensis* (c) | 12.72(0.56) | *Sanguisorba minor* (x) | 16.96(1.44) |
| *Briza media* (I) | 11.08(0.52) | *Koeleria macrantha* (d) | 0.38(0.08) | *Scabiosa columbaria* (y) | 0.19(0.07) |
| *Bromopsis erecta* (J) | 8.44(0.99) | *Lathyrus pratensis* (e) | 0.14(0.78) | *Stellaria media* (z) | 0.01(0.01) |
| *Campanula rotundifolia* (K) | 0.08(0.05) | *Leontodon hispidus* (f) | 12.17(2.01) | *Taraxacum officinale agg.* (Aa) | 0.13(0.05) |
| *Carex flacca* (L) | 18.99(0.58) | *Linum catharticum* (g) | 4.68(0.55) | *Thymus polytrichus* (Bb) | 0.31(0.15) |
| *Centaurea nigra* (M) | 10.23(0.90) | *Listera ovata* (h) | 0.02(0.02) | *Tragopogon pratensis* (Cc) | 0.05(0.02) |
| *Centaurea scabiosa* (N) | 0.45(0.16) | *Lotus corniculatus* (i) | 21.33(0.38) | *Trifolium pratense* (Dd) | 7.86(0.84) |
| *Cirsium eriophorum* (O) | 0.05(0.05) | *Medicago lupulina* (j) | 0.15(0.04) | *Trifolium repens* (Ee) | 0.85(0.54) |
| *Crataegus monogyna* (P) | 1.93(0.43) | *Ophrys insectifera* (k) | 0.03(0.02) | *Trisetum flavescens* (Ff) | 3.10(0.39) |
| *Dactylis glomerata* (Q) | 10.38(0.55) | *Pilosella officinarum* (l) | 2.10(0.30) | *Ulex europaeus* (Gg) | 0.10(0.06) |
| *Dactylorrhiza fuschii* (R) | 2.46(0.44) | *Pimpinella saxifraga* (m) | 0.92(0.24) | *Veronica chamaedrys* (Hh) | 0.03(0.02) |
| *Elymus caninus* (S) | 0.01(0.01) | *Pinus sylvestris* (n) | 0.01(0.01) | *Viola hirta* (Ii) | 1.99(0.52) |
| *Euphrasia officinalis* agg. (T) | 0.13(0.77) | *Plantago lanceolata* (o) | 3.63(0.65) | *Viola odorata* (Jj) | 0.05(0.03) |
| *Festuca rubra* (U) | 1.82(0.24) | *Polygala vulgaris* (p) | 1.50(0.34) | | |

**Appendix 3**. Changes in the 1m$^2$ quadrats across years. Quadrats are identified by their number in Appendix 1. Numbers in each cell denote species richness, Simpson's diversity (1/D), occupancy weighted Ellenberg nitrogen score, False Brome occupancy, and woody scrub species occupancy.

| Quadrat | 2003 | 2004 | 2005 | 2008 | 2009 | 2011 |
|---|---|---|---|---|---|---|
| 1 | 21, 11.24, 3.85, 7, 4 | 23, 15.22, 3.43, 11, 7 | 21, 12.77, 3.59, 7, 5 | 24, 14.65, 3.48, 4, 6 | 24, 12.72, 3.40, 5, 7 | 22, 15.25, 3.41, 11, 7 |
| 2 | 17, 6.47, 3.50, 24, 4 | 17, 9.56, 3.66, 25, 4 | 21, 11.72, 3.63, 24, 3 | 21, 11.43, 3.35, 21, 8 | 17, 12.62, 3.69, 19, 7 | 19, 11.32, 3.67, 14, 9 |
| 3 | 19, 11.22, 3.67, 20, 0 | 17, 10.63, 3.41, 21, 0 | 21, 14.80, 3.57, 16, 0 | 21, 13.93, 3.48, 15, 0 | 22, 14.06, 3.54, 20, 0 | 20, 13.60, 3.43, 16, 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 22, 10.66, 3.44, 0, 11 | 20, 9.39, 3.15, 0, 10 | 18, 10.75, 3.41, 0, 10 | 19, 12.24, 3.19, 1, 11 | 24, 15.62, 3.43, 4, 20 | 23, 13.68, 3.35, 3, 7 |
| 5 | 23, 14.95, 3.61, 0, 7 | 23, 14.44, 3.49, 2, 3 | 20, 12.48, 3.55, 4, 3 | 26, 14.71, 3.31, 4, 2 | 19, 14.18, 3.62, 4, 4 | 23, 14.23, 3.41, 1, 3 |
| 6 | 22, 10.41, 3.60, 5, 3 | 23, 11.84, 3.38, 8, 2 | 22, 12.56, 3.65, 3, 2 | 20, 11.04, 3.65, 7, 2 | 24, 14.05, 3.39, 9, 2 | 25, 14.73, 3.64, 13, 2 |
| 7 | 21, 11.00, 3.49, 10, 0 | 17, 11.66, 3.11, 15, 0 | 21, 12.88, 3.47, 11, 0 | 20, 13.24, 3.24, 15, 0 | 13, 11.19, 3.36, 18, 0 | 18, 12.28, 3.29, 17, 0 |
| 8 | 17, 8.48, 3.44, 22, 0 | 17, 9.65, 3.15, 25, 0 | 19, 12.57, 3.42, 17, 0 | 21, 12.78, 3.42, 19, 0 | 18, 11.18, 3.23, 20, 1 | 23, 12.66, 3.31, 23, 1 |
| 9 | 19, 11.37, 3.29, 22, 1 | 15, 9.29, 3.36, 25, 3 | 21, 12.76, 3.50, 23, 4 | 22, 13.56, 3.32, 15, 4 | 21, 12.51, 3.29, 18, 2 | 15, 11.52, 3.42, 21, 3 |
| 10 | 26, 15.54, 3.40, 24, 1 | 17, 10.34, 3.40, 25, 0 | 22, 13.78, 3.31, 6, 1 | 18, 12.36, 3.11, 8, 0 | 16, 10.82, 3.33, 10, 1 | 20, 12.56, 3.44, 10, 1 |
| 11 | 26, 16.19, 3.47, 10, 1 | 19, 10.69, 3.14, 8, 0 | 18, 11.81, 3.64, 8, 0 | 19, 13.39, 3.55, 17, 1 | 25, 17.65, 3.33, 10, 2 | 23, 13.84, 3.44, 12, 1 |
| 12 | 21, 10.86, 3.27, 1, 2 | 20, 10.87, 3.21, 2, 2 | 24, 15.60, 3.40, 4, 0 | 25, 15.15, 3.37, 9, 4 | 17, 11.57, 3.68, 1, 0 | 20, 11.78, 3.42, 2, 1 |
| 13 | 21, 13.65, 3.24, 1, 0 | 24, 17.07, 3.01, 3, 0 | 22, 13.76, 3.10, 0, 0 | 22, 13.85, 2.94, 4, 1 | 16, 10.82, 3.33, 10, 1 | 22, 14.73, 2.97, 0, 2 |
| 14 | 24, 15.09, 3.34, 2, 2 | 21, 12.70, 3.35, 0, 2 | 25, 12.61, 3.58, 0, 0 | 28, 16.90, 3.74, 19, 5 | 16, 9.93, 3.43, 1, 0 | 20, 14.08, 3.71, 4, 2 |
| 15 | 18, 11.61, 3.17, 0, 0 | 18, 12.54, 3.23, 0, 2 | 19, 11.51, 3.41, 0, 0 | 21, 13.05, 3.28, 7, 0 | 19, 11.10, 3.15, 1, 0 | 20, 11.88, 3.17, 4, 3 |
| 16 | 20, 11.79, 3.31, 8, 0 | 24, 15.48, 3.31, 14, 2 | 28, 16.54, 3.31, 7, 4 | 26, 18.09, 3.35, 10, 2 | 19, 13.49, 3.35, 18, 3 | 25, 14.73, 3.23, 15, 1 |
| 17 | 16, 9.48, 2.97, 7, 2 | 16, 9.63, 3.23, 7, 1 | 15, 9.10, 3.36, 3, 0 | 16, 10.89, 3.31, 0, 3 | 14, 10.12, 2.95, 5, 0 | 19, 9.96, 2.91, 2, 1 |
| 18 | 20, 11.42, 3.26, 14, 1 | 22, 12.62, 3.09, 1, 0 | 26, 15.87, 3.45, 9, 1 | 21, 12.64, 3.23, 8, 1 | 20, 11.88, 3.14, 7, 1 | 23, 15.44, 3.20, 10, 2 |
| 19 | 20, 10.82, 3.16, 0, 3 | 20, 11.57, 3.08, 0, 7 | 28, 17.39, 3.38, 0, 3 | 21, 10.98, 2.98, 1, 1 | 20, 13.22, 3.14, 0, 5 | 27, 12.08, 3.04, 0, 4 |
| 20 | 24, 11.78, 3.21, 0, 4 | 21, 12.78, 3.42, 0, 4 | 16, 11.02, 3.47, 0, 3 | 25, 15.56, 3.35, 0, 5 | 20, 12.73, 3.15, 0, 4 | 24, 14.63, 3.10, 0, 6 |
| 21 | 14, 8.85, 3.42, 2, 1 | 20, 12.25, 3.36, 3, 5 | 25, 12.79, 3.01, 6, 1 | 21, 13.91, 3.46, 0, 6 | 21, 12.16, 3.33, 1, 5 | 19, 12.30, 3.17, 1, 0 |
| 22 | 22, 12.47, 3.55, 7, 2 | 19, 10.53, 3.54, 5, 2 | 20, 12.07, 3.66, 6, 3 | 20, 11.39, 3.17, 7, 0 | 21, 13.24, 3.47, 9, 0 | 24, 14.38, 3.47, 10, 0 |
| 23 | 19, 10.04, 3.30, 0, 0 | 17, 10.13, 3.20, 0, 3 | 23, 12.10, 3.46, 2, 0 | 24, 12.97, 3.38, 0, 0 | 18, 10.00, 3.24, 1, 0 | 19, 12.35, 3.16, 0, 1 |
| 24 | 21, 10.45, 3.03, 0, 0 | 16, 9.59, 2.87, 0, 0 | 20, 12.02, 3.21, 0, 0 | 17, 12.42, 3.12, 5, 0 | 15, 10.04, 3.10, 0, 2 | 19, 11.27, 3.03, 0, 1 |

# Local effects of climate change - has the date of first emergence changed in several species of Lepidoptera in Yorkshire during the period 1995 to 2014?

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**Introduction**

The Earth has undergone a period of sustained growth in global average temperature from the early twentieth century onwards (Stott *et al.*, 2000; IPCC, 2013). The impact of substantial climate change upon Lepidoptera includes such changes as shifts in first emergence date and peak flight date, in flight period length and pattern, in voltinism, abundance, distribution, etc. (e.g., Sparks & Yates, 1997; Roy & Sparks, 2000; Asher *et al.*, 2001; Diamond *et al.*, 2011; Karlsson, 2014). Given that climate change is likely to affect all flora and fauna to a greater or lesser extent, and that each species lies in the middle of a complex web of interdependencies with the rest of nature, the way that climate change ramifies upon any given species may not be simple.

Yorkshire is a particularly interesting arena to test for the effect of global temperature increases upon butterfly emergence patterns, lying as it does at a sufficiently northerly latitude (between 53° 18' N and 54° 40' N) that many butterflies are (or were) at the northern edge of their range where they are particularly sensitive to climate change. Interestingly, in the last few decades, we have seen butterflies once rare or absent in Yorkshire, such as the Comma *Polygonia c-album*, Speckled Wood *Pararge aegeria* and Holly Blue *Celastrina argiolus*, sweep northwards to become commonplace (Asher *et al.*, 2001; Fox *et al.*, 2007). Butterflies are poikilothermic, and are heavily dependent on external air temperature and incident sunlight to raise their body temperature to levels at which they are able to mate and lay eggs (at least 18-28°C). During winter months, butterflies enter diapause – a period of physiological dormancy to survive colder temperatures – in a variety of overwintering states (e.g., Brown Hairstreak *Thecla betulae*, egg; Meadow Brown *Maniola jurtina*, larva; Orange-tip *Anthocharis cardamines*, pupa; Brimstone *Gonepteryx rhamni*, adult). As global surface temperatures have increased since the early twentieth century onwards (IPCC, 2013), this has coincided with earlier emergence (e.g., Sparks & Yates, 1997; Roy & Sparks, 2000), perhaps because the insects are awakened from diapause at an earlier point of the year.

We wished to (a) quantify date of *first emergence* of a range of butterfly species in Yorkshire from 1995 to 2014, (b) investigate what changes in temperature there might have been in Yorkshire over the same time period and (c), explore the relationship between date of first emergence and temperature. The years between 1995 and 2014 represent the longest range over which we have detailed and plentiful records of butterflies in Yorkshire, representing a period of time of sufficient length to potentially demonstrate historical change in phenology

(Roy & Sparks, 2000) and is the first systematic analysis of local effects of climate change upon date of first emergence in Yorkshire's butterflies.

The criteria for the choice of species were that the butterflies should be a mix of habitat generalists and specialists, have an early spring emergence, be easily identifiable by recorders, should not overwinter as adults, should be from different families and be present in sufficiently large numbers so as not to invite sampling problems. Some of these choices are motivated by pragmatic reasons, such as a wish to increase our sampling pool, to reduce opportunities for recorder misidentifications[1] and to discount early sightings of hibernating adults due to physical disturbance or one-off warm days. The choice of having a mix of generalists and specialists, across a range of families, is to strengthen the applicability of our results to all butterflies. Finally, studies have shown that earlier emergence of butterfly species is especially marked for spring species (Sparks & Yates, 1997; Roy & Sparks, 2000). As such, we chose a 'Nymphalid' (Nymphalidae), the Speckled Wood; a 'Blue' (Lycaenidae), the Holly Blue ; a 'White' (Pieridae), the Orange-tip *Anthocharis cardamines*; and a 'Skipper' (Hesperidae), the Dingy Skipper *Erynnis tages*.

**Method**

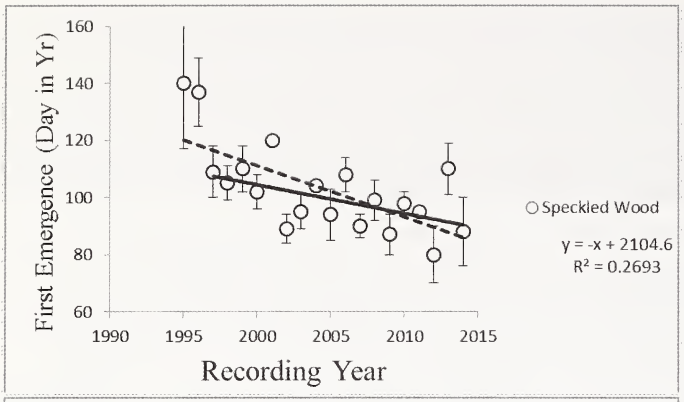
We searched the Butterfly Conservation database for records of our target species for the period 1995 to 2014 from the five Watsonian vice-counties (VC61-VC65) traditionally comprising the county of Yorkshire for recording purposes. For each year we found the dates of the five earliest records of each target species and took the mean. This provided a reasonably unbiased estimate of each year's date of first emergence for each species.

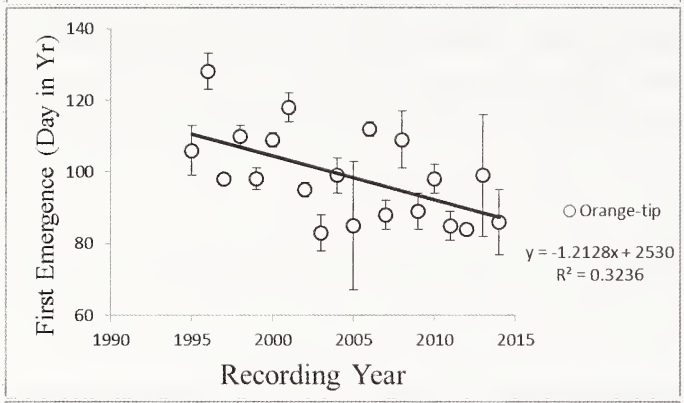
We analysed the butterfly data using a bivariate Pearson's correlation, with the variables of year of recording and mean date of the five earliest records for each year. We are interested in exploring how date of first emergence and year co-vary, so we adopted a non-directional two-tailed analysis. The equation of the best-fitting line (least squares linear regression) to the data was used for the purposes of quantifying changes in date of first emergence. This general statistical approach was used to analyse local and regional temperature data series (variables year of recording and temperature), and to compare temperature and date of first emergence.

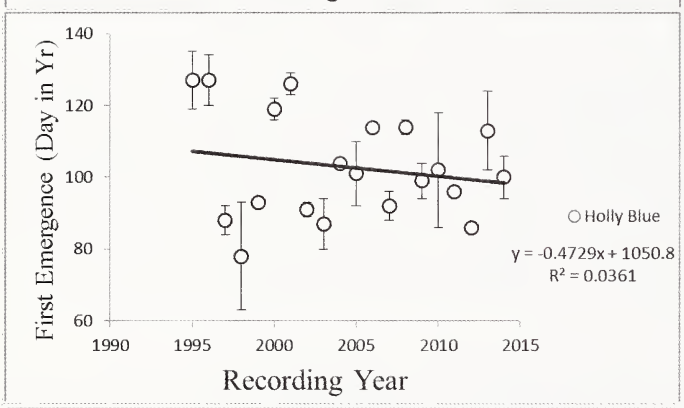
**Results**

Date of first emergence was significantly inversely related to recording year for Speckled Wood ($r(16) = -0.52$, 95% BCa CI [-0.824, -0.057], $p = 0.027$), Orange-tip ($r(18) = -0.57$, 95% BCa CI [-0.781, -0.261], $p = 0.009$), Dingy Skipper ($r(18) = -0.45$, 95% BCa CI [-0.747, -0.180], $p = 0.049$), and insignificantly related to recording year for Holly Blue ($r(18) = -0.19$, 95% BCa CI [-0.680, 0.422], $p = 0.422$ *NS*). The scatter plots and lines of best-fit (linear regression) are shown in Figure 1.:

[1] Small Whites *Pieris rapae* and female Green-veined Whites *Pieris napi* being an obvious misidentification pair



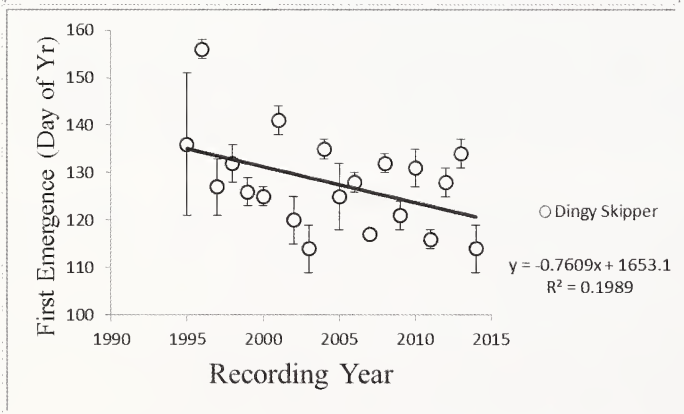




Figure 1.
Day in year of first emergence, as a function of recording year, for Speckled Wood *Pararge aegeria*, Orange-tip *Anthocharis cardamines*, Holly Blue *Celastrinia aegiolus* and Dingy Skipper *Erynnis tages* (p115).
Day of first emergence in each year is calculated by taking the mean of the dates of the five earliest records of each target species. The number of records for 1995 and 1996 were so few for Speckled Wood that those years were omitted from the analysis, hence Speckled Wood is analysed between 1997 to 2014. The best-fitting least squares linear regression line for 1995 to 2014 (Speckled Wood) is dotted and shown for illustrative purposes only. Solid best-fitting least squares linear regression lines are calculated for 1995 to 2014 for all species, except Speckled Wood where it is calculated for 1997 to 2014. Equation shown is for solid least squares linear regression lines. Error bars represent ± 1 standard deviation.

The day of first emergence of Speckled Wood has shifted 17 days earlier[2] in the year between 1997 and 2014; equivalent to 1 day per year or 10 days per decade. Thus in 1997 the mean date of first emergence, using the linear regression equation, would have been 18 April and this had shifted to 1 April by 2014. For the other three species between 1995 and 2014, the shifts are 23 days earlier in the year for the Orange-tip (equivalent to 1.21 days per year); 9 days earlier in the year for the Holly Blue (equivalent to 0.47 days per year) and 14 days earlier in the year for the Dingy Skipper (equivalent to 0.74 days per year). This is consistent with earlier work on British butterflies (Sparks & Yates, 1997; Roy & Sparks, 2000) which suggested climate warming of 3°C could advance date of first emergence by two to three weeks. Table 1 summarises these changes in phenology with additional statistical findings taking into account the variability of the data over the recording years. If a weighted correlation, that takes into account the variability of the data, is applied then the pattern of results is unchanged but the correlation coefficients and level of significance increase even more. There is an undeniable shift towards earlier emergence in the year over the last two decades for three of the butterfly species.

Table 1. Species statistical summary

| Species | $r$[1] | $p$[2] | Day(s)/ yr shift | Start yr[3] | End yr[3] | Start year dfe[4] | End year dfe | $r_w$[5] | $p_w$ |
|---|---|---|---|---|---|---|---|---|---|
| Speckled Wood *Pararge aegeria* | -0.52 | 0.027* | 1.00 | 1997 | 2014 | 18 April | 1 April | -0.53 | 0.025* |
| Orange-tip *Anthocharis cardamines* | -0.57 | 0.009** | 1.21 | 1995 | 2014 | 20 April | 28 March | -0.86 | <0.00001 *** |
| Holly Blue *Celastrina argiolus* | -0.19 | 0.422 (*NS*) | 0.47 | 1995 | 2014 | 17 April | 8 April | -0.30 | 0.205 (*NS*) |
| Dingy Skipper *Erynnis tages* | -0.45 | 0.049* | 0.74 | 1995 | 2014 | 15 May | 2 May | -0.54 | 0.013* |

[1]Pearson's $r$ [2]two-tailed [3]Start and end year within UK BMS (BCY) database [4]Date of first emergence [5]Pearson's $r$ calculated with each year's data weighted in proportion to its variability.
*significant $p$<0.05 **significant $p$<0.01 ***significant $p$<0.001

What should be considered now is whether there has been an actual shift in average temperature in the Yorkshire region in the period of study. Figure 2 plots spring and summer temperature series covering the period from 1995 to 2014 – one from Sherburn in Elmet (roughly in the centre of the county with Lat. 53° 47′ 48″ N, Long. 1° 15′ 26″ W, Elev. 27 m) and

[2] The least-squares line of best fit has equation $y=-x + 2104.6$ (see Figure 1). This is the straight-line linear form $y=mx + c$, where $y$ is date of first emergence (day in year), $x$ is recording year, $c$ is y-axis intercept (=constant) and $m$ is the gradient (=1). The first year of recording period was 1997 so, substituting into the equation, gives the answer of day in year of 108 (rounded to nearest whole integer). This equates to 18 April. Similarly, substituting in last year of the recording period of 2014, gives the answer of day in the year of 91 (=1 April). This is a difference of 17 days. See Table 1 for further details and the other species calculations.

the other from the Central England Temperature (CET) data series. The CET series gives mean temperature readings from the Midlands (extending back to 1659) and is taken to be a reasonable proxy for temperature in other parts of the UK (Duncan, 1991).

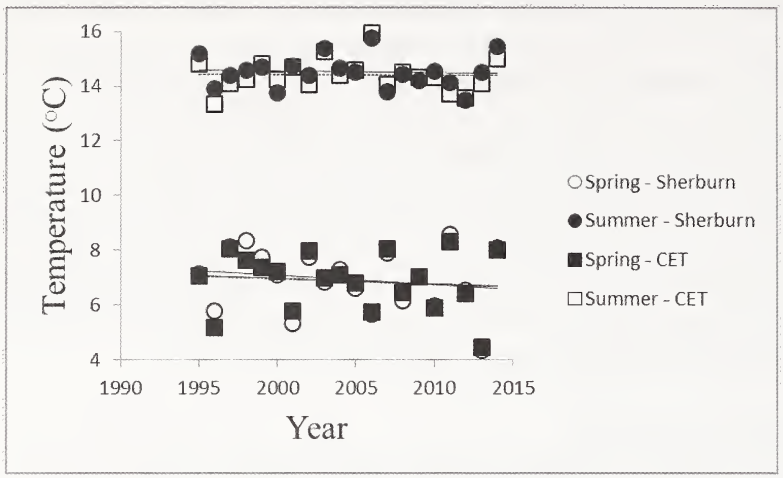



Figure 2. Temperature time series for spring (mean February—April) and summer (mean May—July) calculated from a weather station at Sherburn in Elmet and the Central England Temperature (CET) data set, between the years 1995—2014. Best-fitting lines (least squares linear regression) are solid for Sherburn in Elmet and dotted for CET.

There is little discernible shift in mean spring (February—April), summer (May—July), autumn (August—Oct)[3] and winter (November—January) temperature in Yorkshire between 1995 and 2014. Yorkshire seasonal temperature data series show no significant trends over the twenty year time period: spring temperature series $r(18) = -0.18$, 95% BCa CI [-0.680, 0.357], $p = 0.44$ *NS*; summer temperature series $r(18) = -0.043$, 95% BCa CI [-0.524, 0.423], $p = 0.858$ *NS*; autumn temperature series $r(18) = -0.339$, 95% BCa CI [-0.738, 0.258], $p = 0.143$ *NS*; winter temperature series $r(18) = 0.168$, 95% BCa CI [-0.317, 0.777], $p = 0.478$ *NS*. The cross-check from the CET temperature series against the Sherburn data series shows close agreement. An analysis of the CET and Sherburn data for spring and summer show them to be significantly correlated: spring $r(18) = 0.96$, 95% BCa CI [0.920, 0.986], $p < 0.001$; summer $r(18) = 0.89$, 95% BCa CI [0.746, 0.944], $p < 0.001$. Therefore we can be confident that the Sherburn data is representative of UK temperatures and is not anomalous. If we are to make some link between earlier date of first emergence and increased spring temperatures in the year of emergence (say), then it is not obviously to be found in increased mean spring temperature because there is no increase.

We should not (and logically cannot) rule out the date of first emergence as being temperature dependent. The problem is that what exactly is driving earlier emergence could be buried deep within the temperature series. It is beyond the scope of this report to exhaustively chase all possible factors. We checked for correlations with preceding season (autumn, winter, spring, summer) temperatures and date of first emergence in the subsequent year. In no instance was

[3] To avoid clutter the autumn and winter temperature series for Sherburn and CET are not shown in Figure 2.

there a significant correlation between preceding season and subsequent year date of first emergence (see Table 2). There are then no obvious associations between the temperature data and changes in the dates of first emergence. Perhaps earlier trends in increased temperature (such as the 1.5 $^{o}$C increase in central England spring temperatures between 1976 and 1998 (Roy & Sparks, 2000)) have induced a long-term change that takes years to work through the gene pool of the population? This is beyond the scope of this short report.

Table 2. Correlation between preceding season temperature and date of first emergence in subsequent year (statistical summary)

| Species | Season | $r^1$ | $p^2$ | 95% BCa CI[3] [lower, upper] | df |
|---|---|---|---|---|---|
| Speckled Wood *Pararge aegeria* | autumn | -0.27 | 0.298 | [-0.636, 0.202] | 17 |
| | winter | -0.06 | 0.810 | [-0.567, 0.194] | |
| | spring | 0.27 | 0.293 | [-0.261, 0.742] | |
| | summer | -0.29 | 0.268 | [-0.676, 0.355] | |
| Orange-tip *Anthocharis cardamines* | autumn | 0.30 | 0.213 | [-0.257, 0.649] | 19 |
| | winter | 0.03 | 0.896 | [-0.525, 0.400] | |
| | spring | 0.26 | 0.290 | [-0.138, 0.639] | |
| | summer | -0.07 | 0.776 | [-0.478, 0.321] | |
| Dingy Skipper *Erynnis tages* | autumn | 0.20 | 0.414 | [-0.532, 0.640] | 19 |
| | winter | 0.07 | 0.774 | [-0.494, 0.473] | |
| | spring | 0.37 | 0.123 | [-0.127, 0.770] | |
| | summer | -0.09 | 0.716 | [-0.702, 0.374] | |

[1]Pearson's *r* [2]two-tailed [3]Bias corrected accelerated confidence intervals for the correlation coefficient.

Another concern is a possible intervening relationship between increased observer effort and earlier emergence dates. Basically, the more 'abundant' the butterfly (which again might be no more than an intervening variable for having more observers around actively recording), then the greater the chance for a given individual butterfly to be seen. Thus increased observer effort or increased abundance can theoretically lead to a pattern of apparent earlier emergence. This is hinted at in Figure 1 for Speckled Wood, where the mean dates of first emergence for 1995 and 1996 were both late in the year and associated with a great deal of uncertainty (shown by the large standard deviations). The dates of first emergence were presumably late in the year and more variable because Speckled Wood was present in very small numbers in those years (having only just reached the southern borders of Yorkshire in a general northwards movement, see Asher *et al.*, 2001), so the chance of spotting a Speckled Wood was relatively small. This could lead to a confounding effect where the specimens seen are not necessarily newly emerged but could be post-emergent adults by a number of days or even weeks. However, it is hard to see how changes of up to 17 days (Speckled Wood) could be accounted for by an increased chance to spot individual butterflies once a species has become relatively well established in the region. Interestingly, Speckled Wood abundance peaked in Yorkshire in 2009 with recorded numbers in the last five years dropping by a factor of two but with little discernible change in observed date of first emergence. The particularly late date of first

emergence in 2013 was attributable to the severe spring in that year. Further work on possible interactions of increased observer effort and changes in recorded first emergence will be needed to clarify the role of climate change upon driving changes in phenology, both at the local and global scale.

**Acknowledgements**

We are grateful to the UK BMS and Butterfly Conservation and its volunteer recorders, for the butterfly records from Yorkshire (VC61-65) upon which this research is based. Dave Ramsden provided the temperature series for Sherburn in Elmet and the Central England Temperature (CET) series was downloaded from www.metoffice,gov.uk/hadobs. We wish to thank an anonymous reviewer for helpful comments.

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# A Question of Ecology - answers from biological recording

**Paula Lightfoot**, NFBR

The British Ecological Society Macroecology Special Interest Group and the National Forum for Biological Recording organised a joint conference in late April 2015 at the University of Sheffield. The event was attended by 100 delegates from a wide range of organisations involved in collecting, managing, interpreting and using biodiversity information.

Biodiversity information is crucial to understanding ecological relationships and supporting conservation effort in a changing climate. Use of volunteer-collected biological records by the professional scientific community is widely encouraged and celebrated, but interpretation of biological records is also carried out by amateur naturalists, who are uncovering new ecological knowledge from their own records and sharing that knowledge with others. Biological recording is not just about producing checklists, dot maps or providing 'big data' for others to analyse; it is a way of engaging with the natural world which raises questions and provides answers to them.

A Question of Ecology celebrated achievements, highlighted opportunities and sought to overcome obstacles regarding the use of biological records to answer ecological questions.
The conference aimed to:

- Raise awareness of how biological records can be interpreted to answer ecological questions and lead to conservation action.
- Empower volunteer recorders and their organisations to get more out of their biological records by highlighting effective approaches to data collection and analysis.
- Foster collaboration between the professional research community and volunteer recording community through examples of good practice.
- Discuss barriers to the use of biological records for research and start a dialogue between the recording and research communities about how to overcome those barriers.

The conference began with a demonstration workshop on software and tools for capturing and interpreting biological records, including rNBN, SPARTA (Species Presence/Absence R Trends Analyses), Scratchpads, Indicia and QGIS. This was a lively interactive session, and delegates were inspired by the enthusiasm of the presenters and the opportunities provided by new technology.

This was followed by a workshop in which challenges and opportunities regarding the collection and interpretation of biological records for ecological research were discussed. Topics included DNA techniques, Open Data and data quality. The diverse range of sectors present at the conference and the mix of delegates' experience, knowledge and viewpoints ensured a useful and informative debate. One delegate from the research community stated that "the most valuable thing about the conference was the opportunity to fill the gap between my models and the data that goes into them, by speaking directly with the people that collect those data."

The programme on the second day highlighted original work at all scales and levels, from global to local, where knowledge of species and systems is being advanced through accurate

observation and recording. Professor Kate Jones from University College London and Bat Conservation Trust opened proceedings with an excellent keynote address on the topic of *Technology for Nature?* This was followed by a session dealing with methods for analysing 'big data' to understand a changing environment, with speakers including Dr David Roy from the Biological Records Centre and Dr Jon Yearsley from University College Dublin. Delegates from the volunteer recording community and the professional research community alike were inspired to learn how large, unstructured datasets can be analysed to provide insight into trends in populations and ranges.

The focus then shifted to the collection and interpretation of data on a local scale, particularly the role of local environmental records centres and natural history societies in supporting this. Dr Teresa Frost presented examples of how Cumbria Biodiversity Data Centre empowers volunteer recorders to get more out of their biological records by assisting with survey design, data management and analysis. Dr Andy Millard reported on the initiatives being undertaken by the YNU, with particular reference to the use of *The Naturalist* to disseminate information.

After lunch, delegates heard how biological records from museum specimens and naturalists' diaries can be explored and interpreted to answer ecological questions. Ivan Wright from Shotover Wildlife described how local naturalists are following in the footsteps of eminent entomologists of the Victorian and Edwardian era, comparing current data to historic records to establish a new benchmark of knowledge for a fascinating and diverse SSSI near Oxford. Dr Mark Spencer from the Natural History Museum, London, explained how new approaches to citizen science and crowd-sourcing can release a wealth of scientific information from the natural history collections that await discovery in our museums.

Speakers from Newcastle University and the Woodland Trust went on to describe cutting-edge citizen science projects that are engaging amateur naturalists in structured data collection to support hypothesis-driven science, fostering collaboration between professional researchers, the public sector and the volunteer recording community. The conference concluded with case studies to highlight how research based on biological records by amateur naturalists is leading to conservation action, from site-specific to landscape-scale examples. An excellent range of posters were displayed, complementing the programme of talks. Peter and Sharon Flint presented their investigation of the caddisflies of Malham Tarn (see page 121) in one of these.

On Saturday there was a very enjoyable and well-attended field meeting to Thorne and Hatfield Moors, organised by Yorkshire Wildlife Trust and Natural England. Thorne and Hatfield Moors form the core of the Humberhead Peatlands NNR, the largest lowland raised mire system in the UK and the beating heart of the Nature Improvement Area. This was an excellent opportunity to see examples of how science can influence conservation action and delivery on a landscape scale – and to get out and enjoy some biological recording at a beautiful site! Species records from the field trip have been collated and will be shared via the NBN Gateway.

NFBR and BES Macroecology SIG would like to thank the speakers, chairs, workshop facilitators, software demonstrators, poster exhibitors and all the delegates for participating so actively and enthusiastically and making the conference such a great success! A version of this report has been published in the BES Bulletin.

Plate I. Ellerburn Bank. See pp 96-111.

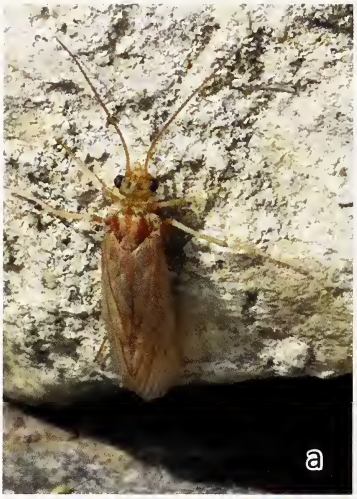
*Above left* (a): View of the sward looking south. Visible are Common Spotted Orchids, Common Bird's-foot-trefoil, Salad Burnet, Upright Brome, Quaking Grass and Cock's-foot.

*Above right* (b): Looking east along the reserve, a patch of invading scrub, mainly Hawthorn, surrounded by the wide yellow leaves of False Brome.

*Below left* (c): Gorse invading the south-eastern part.

*Below right* (d): View of the sampled area at Ellerburn Bank, looking north-east. Small Hawthorn and Gorse bushes are visible in the grass, with yellow patches of False Brome.

*P. Mayhew*



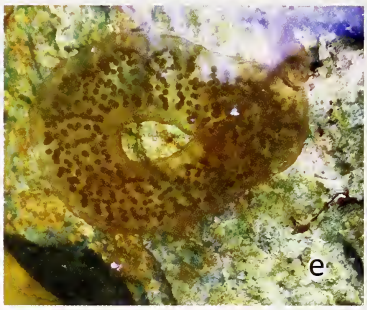


Plate II. Caddisflies at Malham Tarn. See pp 121-127.

a) The Malham Sedge *Agrypnetes crassicornis*, adult female among the rocks on the shore of Malham Tarn near the East Boathouse. *S. Flint*

b) The Malham Sedge, mature larva and its case. *S. Flint*

c) The Grouse Wing *Mystacides longicornis*, adult male on a rock on the north shore of Malham Tarn. *S. Flint*

d) Egg masses of *Limnephilus politus*, with spent females, among moss-covered rocks at the high water level on the north shore of Malham Tarn. *S. Flint*

e) Phryganeid egg ropes, on rocks in shallow water off the west shore of Malham Tarn. *S. Flint*

f) Grapnel sampling Stonewort *Chara* sp., from a boat on Malham Tarn off the wooded shore near the East Boathouse. *P. Flint*

Plate II continued

g) Larval case of *Limnephilus politus*; fixed to leaf of *Potamogeton lucens* and with the ends closed using fragments of marl; ready for pupation.

h) *Limnephilus politus*, adult. *S. Flint*

Plate III. Ringinglow Bog, main flush area. See pp 134-145

a) vegetation dominated by Common Cottongrass, December 2014.

b) bog-moss amongst Common Cottongrass, September 2014.

c) tussocks of Hare's-tail Cottongrass, February 2015.

d) bog-moss amongst Hare's-tail Cottongrass, February 2015.

*R. Goulder*

Plate IV. BES/NFBR Conference. See p119. Delegates on the field trip to Thorne and Hatfield Moors.

*P.Lightfoot*

Plate V. Biodiversity of moths in Borneo and China. See pp 81-96.
*Above*: A few of the circa 2,500 Q-CAS voucher specimens from Yunnan, China.
*Right*: Dr Louise Ashton with a Pennsylvania moth trap in tropical forest understorey.
*Below*: *Antheraea larissa* ssp. *ridlyi*; Lepidoptera: Saturniidae. A Bornean rainforest moth.

*T.Whitaker*

# An investigation of the caddisfly (Insecta: Trichoptera) fauna of the Malham Tarn NNR; with special reference to the Malham Sedge *Agrypnetes crassicornis*

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**Introduction**

During the 1950s some of the members of the entomological section of the YNU carried out an extensive investigation of the insect fauna of the area around Malham Tarn. For a period of seven to ten days each year from 1954-1958 this group, led by W. D. Hincks and J. H. Flint, were resident at Tarn House which had recently become a Field Studies Centre run by the Field Studies Council. The then warden of the centre, P. F. Holmes, who had a strong interest in caddisflies, took an active part in this investigation and wrote the section of the published report (Henson, 1963) concerning them. Seventy one species of caddis flies were recorded in the study area; which included the upper reaches of the nearby Gordale, Cowside and Darnbrook becks. This is approximately a third of the British caddis fly list and underlines Malham as an important area for this group of insects. Most of the caddis collecting was carried out by P.F. Holmes (who incorporated his records from 1948 onwards into the report) and A. Brindle. During 2013 a study of the caddisflies of the current Malham Tarn National Nature Reserve, a much smaller area than that covered by the 1950s study, was undertaken by S. and P.W.H. Flint. A good description, and historical review, of this high moorland site (centred on NGR SD890670; at c.380m above sea level) set in the karst landscape of the Yorkshire Dales National Park, is given by Corey Jones (Centre Director of the Malham Tarn Field Centre 1997-2000) in the magazine *British Wildlife* (Jones, 2001) and need not be repeated here.

**Aims**

The aims of the 2013 study were threefold. Firstly, as there had been no concentrated work on the caddis of the area for many years, we wanted to bring the list of the Malham caddis fauna up to date; and into line with current taxonomy. Were the species which had been previously recorded still present? Secondly we wanted to find out more about the ecology of these species. What observations could we make of adult behaviour such as swarming and oviposition? Where were the larvae to be found; and what were they doing? Thirdly we wanted to know whether *Agrypnetes crassicornis* McLachlan (recently honoured with the vernacular name 'Malham Sedge') discovered at Malham Tarn by P.F. Holmes in 1950, was still present as a breeding species in its only known, British, locality.

**Methods**

Larvae were collected by pond netting in the standing and running water habitats where this was practicable and by hand searching where use of the net was not practicable. A grapnel was used for sampling the vegetation in the tarn both from the shore and from a boat. Collecting commenced in mid-April and continued until the end of October.

Adults were collected from the ground vegetation, and from the lower canopy of the trees, by the use of a sweep net. The net was also used to catch flying specimens. A malaise trap was deployed on Malham Fen, the catch from which was collected fortnightly from the middle of April to the end of October. The catch from an actinic light trap, situated in one of the cottage gardens, just off the fen, and operated from the end of April until the end of July, was also examined. Hand searching of the rocks around the tarn shore, and other likely resting places such as the boat houses, birdwatching hide, tree trunks and post and rail fences, was also undertaken during the day. Observations were extended well into the evenings as many species are crepuscular and this was thought to be the best time to find the adults of *A. crassicornis*.

Nomenclature follows the checklist in Barnard and Ross (2012). Most caddis species do not have vernacular names but some have been included, where appropriate, in the body of the text. Adults were identified using both Barnard and Ross, and Macan (1973). Larvae were identified using Edington and Hildrew (1995) and Wallace, Wallace and Philipson (2003).

**Results**

Table 1. List of species recorded during the 2013 survey compared with the list published in 1963.

| | **2013 List** | | | | | | | | | **1963 List** |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Adults** | | | | **Larvae** | | | | **All records** | **All records** |
| Taxa | Sweep net sampling | Malaise trapping | Light trapping | Hand searching | Malham Tarn | Ponds on Fen & Moss | Streams on Fen | Stream E Shore of Tarn | | |
| **Rhyacophilidae** | | | | | | | | | | |
| *Rhyacophila dorsalis* | | | √ | | | | | | √ | √† |
| *R. fasciata* | | | √ | | | | | | √ | √ |
| *R. munda* | | | | | | | | | | √† |
| *R. obliterata* | | | | | | | | | | √† |
| **Glossosomatidae** | | | | | | | | | | |
| *Agapetus fuscipes* | | | | | | | | | | √ |
| **Hydroptilidae** | | | | | | | | | | |
| *Agraylea multipunctata* | | | | √ | √ | | | | √ | √ |
| *A. sexmaculata* | | | | | | | | | | √ |
| *Hydroptila angulata* | | | | | | | | | | √† |
| *H. forcipata* | | | | | | | | | | √ |
| *H. tineoides* | | √ | | | | | | | √ | √ |
| *H. vectis* | | | | | | | | | | √† |
| *Oxyethira falcata* | | | | | | | | | | √† |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *O. flavicornis* | | √ | | | | | | | √ | √ |
| **Philopotamidae** | | | | | | | | | | |
| *Philopotamus montanus* | | | | | | | | | | √† |
| *Wormaldia subnigra* | | | | | | | | | | √† |
| **Polycentropodidae** | | | | | | | | | | |
| *Cyrnus flavidus* | | | | | | | | | | √ |
| *C. trimaculatus* | | √ | | | | | | | √ | √ |
| *Neureclipsis bimaculata* | | | | | | | | | | √* |
| *Plectrocnemia conspersa* | | | | | | | √ | | √ | √ |
| *Polycentropus flavomaculatus* | | √ | √ | | | | | | √ | √ |
| *P. irroratus* | √ | | | | | | | | √ | |
| **Psychomyiidae** | | | | | | | | | | |
| *Lype phaeopa* | | | | | | | | | | √ |
| *Psychomyia fragilis* | | | | | | | | | | √† |
| *P. pusilla* | | | | | | | | | | √* |
| *Tinodes dives* | | | | | | | | | | √† |
| *T. rostocki* | | | | | | | | | | ?† |
| *T. waeneri* | √ | √ | | | √ | | | | √ | √ |
| **Hydropsychidae** | | | | | | | | | | |
| Hydropsyche instabilis | | | | | | | | | | √† |
| H. siltalai | | | √ | | | | | | √ | |
| **Phryganeidae** | | | | | | | | | | |
| *Agrypnetes crassicornis* | | | | √ | √ | | | | √ | √ |
| *Agrypnia obsoleta* | | √ | | | | √ | | | √ | √ |
| *Oligotricha striata* | | √ | | | | √ | | | √ | √ |
| *Phryganea bipunctata* | √ | | √ | √ | | | | | √ | √ |
| **Lepidostomatidae** | | | | | | | | | | |
| *Lepidostoma hirtum* | | | | | | | | | | √* |
| **Limnephilidae** | | | | | | | | | | |
| *Drusus annulatus* | √ | | | | | | √ | | √ | √ |
| *Ecclisopteryx dalecarlica* | | | √ | | | | | | √ | |
| *Chaetopteryx villosa* | √ | √ | | | | | √ | | √ | √ |
| *Anabolia nervosa* | √ | | | | √ | | √ | | √ | √ |
| *Glyphotaelius pellucidus* | | √ | | | | | | | √ | |
| *Limnephilus affinis* | | | | | | | | | | √* |
| *L. auricula* | | | | | | | | | | √ |
| *L. centralis* | | | | | | | | | | √ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *L. coenosus* | | √ | | | | | | | √ | √ |
| *L. elegans* | | √ | | | | | | | √ | √ |
| *L. extricatus* | | | √ | | | | | | √ | √ |
| *L. griseus* | | | | | | | | | | √* |
| *L. hirsutus* | | √ | | | | | | | √ | |
| *L. incisus* | | √ | | | | | | | √ | √ |
| *L. lunatus* | √ | √ | √ | | √ | | √ | | √ | √ |
| *L. luridus* | | √ | √ | | | | | | √ | √ |
| *L. politus* | √ | | √ | √ | √ | | | | √ | √ |
| *L. rhombicus* | | | √ | | √ | | √ | | √ | √ |
| *L. sparsus* | | √ | | | | | | | √ | √ |
| *L. stigma* | | √ | | | | √ | | | √ | √ |
| *L. vittatus* | | | | | | | | | | √* |
| *Rhadicoleptus alpestris* | | | √ | | | | | | √ | √ |
| *Halesus digitatus* | | | | | | | | | | √ |
| *H. radiatus* | | | | | √ | | √ | | √ | √ |
| *Hydatophylax infumatus* | | | | | | | √ | | √ | √* |
| *Melampophylax mucoreus* | √ | | | | √ | | √ | | √ | √ |
| *Mesophylax impunctatus* | | | | | √ | | | | √ | √ |
| *Micropterna lateralis* | | √ | | | | | | √ | √ | |
| *M. sequax* | | | | | | | √ | √ | √ | √* |
| *Potamophylax latipennis* | | | √ | √ | | | | | √ | √ |
| *P. rotundipennis* | | | | | √ | | √ | | √ | |
| *P. stellatus* | | | | | | | | | | √ |
| *Stenophylax permistus* | | | √ | | | | | | √ | √ |
| *S. vibex* | | | | | | | | | | √* |
| **Sericostomatidae** | | | | | | | | | | |
| *Sericostoma personatum* | √ | √ | | | √ | | | | √ | √ |
| **Beraeidae** | | | | | | | | | | |
| *Beraea pullata* | | √ | | | | | | | √ | √ |
| *Beraeoides minutus* | | | | | | | | | | √ |
| **Odontoceridae** | | | | | | | | | | |
| *Odontocerum albicorne* | | | √ | | | | | | √ | √ |
| **Leptoceridae** | | | | | | | | | | |
| *Arthripsodes cinereus* | √ | | √ | | | | | | √ | √ |
| *Ceraclea albimacula* | | | √ | | | | | | √ | |
| *C. fulva* | √ | | | | √ | | | | √ | √ |
| *C. nigronervosa* | √ | | | | | | | | √ | √ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Mystacides azurea* | √ | | | | | | | | √ | √ |
| *M. longicornis* | √ | | | | √ | | | | √ | √ |
| *M. nigra* | | | | | | | | | | ?* |
| **Totals** | **15** | **20** | **17** | **5** | **14** | **3** | **11** | **2** | **50** | **71** |

(? Indicates tentative identification; † indicates species recorded outside the current NNR; *indicates single specimen)

**Discussion**

Of the 29 species listed in 1963 and not recorded by us, 11 occurred outside the current reserve area and 8 were only recorded as single specimens. We have recorded 8 species which were not listed in 1963, bringing the total number of species for the area as a whole to 79, with 68 species being recorded within the current NNR. Thus more than a third of the 196 currently recognised British species have now been recorded from the NNR itself.

Adults of 44 species were recorded during 2013, two of which (*Agrypnetes crassicornis* and *Agraylea multipunctata*) were only found by hand searching along the shore of the tarn. The Malaise trap produced the largest number (20 species) though this was slightly less than half the total recorded. The Light trap and sweep net sampling produced very similar numbers (17 and 15) though only four species were taken by both methods (only one species, Cinnamon Sedge *Limnephilus lunatus*, was taken by all three methods). Thus the combined total for sweep netting and light trapping was just over half of the total number of adults recorded showing that it is necessary to use several methods in parallel to obtain anything approaching a full species list and even then some species were missed as adults which were found as larvae. For all except one of the species the period of adult activity was as expected. Only in the case of *A. crassicornis*, see below, was adult activity observed outside previously published 'flight times'.

Larvae of 23 species were recorded during 2013; 14 of them in Malham Tarn itself, of which 8 were not found elsewhere on the NNR. The small spring-fed stream entering the east shore of Malham Tarn produced 2 species of *Micropterna*, both *M. lateralis* (which was only found here) and *M. sequax* (which also occurred in the fen runnel). The runnels carrying water through the fen and into Malham Tarn produced 11 species, 4 of which were only found here and 1, (*M. sequax*) was also found in the small stream on the East shore of the tarn; the other 6 species were not confined to running water and were also found in Malham Tarn itself. Only 3 species were recorded from the ponds on the fen, none of which were found elsewhere.

Examination of the *Chara sp.* (Stonewort) beds in the tarn (in the search for *Agrypnetes*) produced large numbers of larvae and pupae of *Limnephilus politus*. Juveniles of this species were found nowhere else and the adults were found all along the northern shore of the tarn, resting and mating on the ground vegetation, and spent females, with abundant egg masses, were found among the mossy stones at the high water level all along the northern shore. Adults of *L. politus* were caught in the light trap which indicates that they were attracted to the light some distance from the tarn but they were not caught in the Malaise trap on the fen. Another abundant species in the tarn was Welshman's Button *Sericostoma personatum* whose larval cases were found all round the edges of the tarn and in the *Chara* beds. The adults of this species are day flyers and were to be seen all over the NNR from mid-June to mid-July flying in

hot, bright, sunshine. Mating pairs of *S. personatum* were found sitting on the upper surfaces of leaves in bright sunshine and were also taken in flight.

Adults of the Hydroptillid *Agraylea multipunctata* were present in enormous numbers and were collected by 'pootering' directly off the rocks around the tarn shore, where they were sitting and running in the sunshine. Final instar larvae, in their cases, were found among the *Chara* and also on the leaves of both Curled Pondweed *Potamogeton crispus*, growing just off shore in Boat House Bay, and Shining Pondweed *P. lucens*, a large stand of which grows out in the middle of the tarn. They were also taken by pond netting in Ha Mire Bay and we sometimes found them attached to the (occupied!) cases of *L. politus* during grapnel sampling. Between mid-June and mid-August males and females of *Oxyethira flavicornis*, another Hydroptilid, were taken in the Malaise trap. Larvae identified as *Oxyethira* sp. (probably *O. flavicornis*) were found in the tarn, attached to both *Potamogeton* spp. and by pond netting in Ha Mire Bay where some of them were attached to (occupied!) cases of L. lunatus, but we did not find the adults here.

A common species on the fen was *Chaetopteryx villosa* whose larvae live in stony cases in the fen runnels and adults of which were found by beating and sweeping along the fen runnels during October when it was also found in the Malaise trap.

The fact that some species are only known on the NNR from single adult records does not necessarily mean that they are vagrant individuals and do not breed here. *Hydatophylax infumatus,* for example, is included in the 1963 list on the basis of a single adult male attracted to a Tilley lamp on the tarn shore at the inflow and we know of no subsequent records. We have not seen any adults but we found two larvae in the main runnel through the fen not far from where that adult was taken. A viable, though possibly small, breeding population must therefore exist here, possibly confined to this small area.

An abundant species round the tarn is Grouse Wing *Mystacides longicornis*, adults of which can be found resting by day on fences and among the ground vegetation. They start to become active in the early evening and large swarms, of males and females, can be seen flying as the light begins to fade and until well into the twilight. Mating pairs can be seen flying and on the leaves of the vegetation near the tarn shore; they can even be seen running on the water surface in calm conditions. Larvae are abundant in the tarn and were found by grapnel sampling the *Chara*.

**The Malham Sedge**

Grapnel sampling from a boat showed that the *Chara*, with which the larvae of *Agrypnetes crassicornis* are associated, and from which the early instars construct their cases (large larvae construct cases of a variety of materials) was widespread but patchy in Malham Tarn. We examined *Chara* from many parts of the tarn but we were only able to find juveniles of *A. crassicornis* in one small area; offshore near the East Boathouse. Three well grown larvae were seen on the 18 June and a dead pupa (in its larval case) on the 28 August. We had also found a live pupa in this same area of the tarn on 7 September 2012. Only a single adult specimen was seen, on the evening of 6 August, when hand searching among rocks on the shore of the tarn in this same area produced a female specimen. This record extends the known period of adult activity into early August (previously it had been recorded between 30 June and 25 July) and the

record of a pupa in the previous September indicates the possibility that adult activity might be even further extended. Adults of this species are regarded as flightless and have been observed running across the surface of the tarn; it is interesting therefore that this specimen was observed to flutter a distance of at least 10cm between the tops of two adjacent rocks before scuttling down into another, narrower, gap. A search for eggs among the rocks just offshore was unsuccessful but it appears that this population is still surviving even if its numbers are low. The records from the 1950s indicate that adult numbers, then, fluctuated from year to year. In the 1963 report P. F. Holmes said of *A. crassicornis* "…. must be some sort of relict species here."; it has since been found, as a sub-fossil in peat deposits some 10 to 15 thousand years old, at two widely separated localities (I. D. Wallace, pers. com.) so it appears that he was right.

*A. crassicornis* is not the only member of the family Phryganeidae in the tarn. Several adults of Great Red Sedge *Phryganea bipunctata* were seen on the north shore of the tarn and very large numbers of pupal exuviae, which we assume to be this species but which it was not possible to confirm the identity of (other than that they were Phryganeidae but not *Agrypnetes*), were found along the western shore at the same time as the adults were flying (mid- to late-June). The adults were flying at dusk and it was noticeable that fish were rising to feed at the surface of the tarn at the same time. No larvae were seen though they must have been present in considerable numbers. Phryganeid egg loops were seen among the rocks off the western shore at the same place as the pupal exuviae were found and we assume that these were also *P. bipunctata*; though the only way to be sure would have been to collect and hatch them, rearing the larvae to sufficient size to be identifiable.

**Acknowledgements**

We thank the National Trust and English Nature for permission to collect specimens on the Malham Tarn NNR. We thank all the staff of the Malham Tarn Field Studies Centre for their enthusiastic support and hospitality, and the use of their boat and other equipment. We thank Robin Sutton for his light trap caddis captures. We thank the YNU for the use of the Malaise trap.

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# Notes on the dolichopodid flies of two contrasting Yorkshire bogs

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Askham Bog near York (SE575481, VC64) is a 44.1ha remnant of a post-glacial mire at an altitude of c.10m which formed behind a terminal moraine to the south, along whose summit now runs the dual carriageway of the A64 York by-pass. It has long been known as a haunt of rare fenland plants and insects, to the extent that in the past it was called 'the Wicken Fen of the North'. There is an account of a visit by boys of York Quaker (now Bootham) School in 1834 in search of water beetles and plants (Fitter & Smith, 1979), and in 1946 the site became the first, and for almost ten years the only, nature reserve of the Yorkshire Naturalists' Trust (YNT), as the Yorkshire Wildlife Trust (YWT) was then known.

Fen Bog (SE857982, VC62) is a valley mire of some 18.3ha at the head of the glacial drainage channel of Newton Dale in the heart of the North York Moors National Park at an altitude of c.150m. It was gifted to the (YNT) in 1964 and it was well known amongst entomologists as a site for a variety of peat-bog insects, including the Large Heath *Coenonympha tullia*.

Although both sites are called 'Bog' they differ markedly in structure: Askham Bog is mainly an alkaline-neutral fen whereas Fen Bog is mostly waterlogged acid peat. The vegetation of the two reserves is quite different but both are superb examples of their types.

These differences are also reflected in the dipterous fauna, of which the Dolichopodidae is an important component. The combined species-list for the two sites numbers 83, of which only 29 are common to both. The total number for Askham Bog now stands at 61, of which 32 have not been recorded from Fen Bog. The total list for the latter numbers 51, of which 22 have not been recorded at Askham Bog.

The 29 species recorded at both sites are mostly widespread and common generalists. Examples are: *Chrysotus gramineus*, *Dolichopus plumipes*, *D. popularis*, *D. ungulatus*, *Gymnopternus aerosus*, *Sybistroma obscurellus*, *Campsicnemus curvipes*, *C. scambus*, *Sympycnus desoutteri and Syntormon pallipes*.

Dolichopodids recorded from Askham Bog only include several which are restricted in their Yorkshire distribution. Noteworthy amongst these, in a regional context, are *Argyra elongata*, *Diaphorus oculatus*, *Dolichopus wahlbergi*, *Ethiromyia chalybea*, *Gymnopternus angustifrons*, *Rhaphium fasciatum* and *Lamprochromus bifasciatus*.

*Argyra elongata* is little known in Yorkshire: first recorded from a water trap on West Fen, Malham (VC64) on 11/9/1980, the next was a single female at Askham Bog on 16/7/1985 (this specimen, much damaged but still identifiable, is in my collection). Much subsequent collecting

at the site has failed to locate any more examples. A third and more recent record by Andrew Godfrey from Inkle Moor, Thorne (VC63) on 25/6/2012 completes the tally. I have taken single specimens at Loch Morlich (Aviemore) and Fenn's/Whixhall Moss (Shropshire), so this dolichopodid is widely spread nationally but apparently always scarce.

*Diaphorus oculatus* was reported by Chris Cheetham from 'Austwick. Lawkland' (VC64) in a note, according to his record card, published in *The Naturalist* in 1919. This remained the only known Yorkshire locality until 1985 when it was recorded at Askham Bog, at which site it has subsequently been found frequently in the fen meadows. It has also been found at the YWT reserves at Ashberry (VC62) and Upper Dunsforth (VC61) and also at Sand Dale on the southern edge of Dalby Forest (VC62), and in 2008 at Ellington Banks near Ripon (VC64). These widely scattered records over the past thirty years doubtless reflect the mobility of the present generation of recorders and an increasing interest in dipterology. The eyes of the males in life are of the most beautiful blue, hence the name.

*Dolichopus wahlbergi* is very similar in general appearance to *D. plumipes,* one of the most common and widespread of dolichopodids. The males of both have distinctive pennate lateral fringes to the basal segments of the middle tarsi and the hind margins of the wings are conspicuously sinuate towards the bases. These are thought to be male secondary sexual characters, and leg adornments in particular occur in a number of dolichopodid genera, especially the species-rich *Dolichopus*. *D. wahlbergi* is found less frequently than *D. plumipes*, usually singly or in very small numbers, and it appears to be absent from much of the upland western parts of Yorkshire.

*Ethiromyia chalybea* was first recorded in Yorkshire in 1987 from the towpath of Doncaster Canal and thereafter from Gypsy Marsh, a wetland site in the south of VC63, in 1992 and 1997 and Holbrook Marsh in 1993. In 1996 a single female was found in a fen bordering Hornsea Mere (VC61) and subsequently at half a dozen further sites, mostly in VC61. The first to be recorded at Askham Bog was in 2010 and further examples were found in the same area of carr-woodland near the entrance to the reserve in 2014.

*Gymnopternus angustifrons* (Lower Risk = Nationally Notable) is a tiny black fly for which there is a record from Askham Bog (date unclear but pre-1953). That remained the sole record until 1971, when it was found at Hotham Carrs (VC61). The next was in 1984 from Askham Bog, where it still occurs, and in the same year from Allerthorpe Common (VC61). Thereafter it has been reported from several other damp, peaty sites in lowland Yorkshire: Skipwith (VC61) and Strensall (VC62) Commons, Thorne Moors and sites in the Lower Derwent Valley (VC61).

*Rhaphium fasciatum* has a long association with Askham Bog, the first record being in 1953. This was the only known Yorkshire site until it was found during the Malham survey undertaken by the Entomological Section of the YNU between 1954/58 (Henson, 1963). Since then it has been recorded from about a dozen widely scattered localities in the county but surprisingly from only one in VC63: Inkle Moor, 2012. At Askham Bog several specimens of both sexes were found in a small area of carr-woodland near the entrance to the Reserve between 1-19 May 2014.

*Lamprochromus bifasciatus* was first recorded in Yorkshire in 1996, when a single male was found at Sand Dale, and there have been several subsequent records from the same locality.

There was a further VC62 record from Ashberry in 2008 and then from Askham Bog in 2013 and 2014.

Dolichopodids reported from Fen Bog but not Askham Bog include *Diaphorus nigricans*, *Dolichopus longitarsis*, *Tachytrechus consobrinus*, *Hydrophorus albiceps*, *Schoenophilus versutus*, *Rhaphium longicorne* and *Syntormon zelleri*.

*Diaphorus nigricans* was first reported in Yorkshire from Thorne Moors in 1975. Since then it has been found at about a dozen widely scattered sites in the county, mainly, but not exclusively, on peat in both lowland and upland localities.

*Dolichopus longitarsis* records are mostly from upland localities, especially calcareous sites on the North York Moors (VC62). There are three known Pennine sites and an isolated coastal one from Easington (VC61). One of the Pennine sites (Bingley Bog) is the only one for VC63 and there are no records from VC65.

*Tachytrechus consobrinus* (Lower Risk = Nationally Notable) was first recorded in Yorkshire at Fen Bog in 2002 and it has been found on several subsequent occasions at this site. Elsewhere on the North York Moors it has been found at Tranmire Bog and Bonfield Gill. The only other Yorkshire record is from the shore of a sandy lagoon on Hatfield Moor (VC63) in 2004.

*Hydrophorus albiceps* was first recorded in Yorkshire at Helwith Moss, Austwick in 1921, and subsequently there have been numerous reports from Pennine localities including Warley Moor Reservoir and Studley Pike (both in VC63). There are two further sites on the North York Moors in addition to Fen Bog – Tranmire Bog and Bonfield Gill. The majority of localities are acid bogs dominated by *Sphagnum* spp. As is the case with some other insects once regarded as being restricted to upland bogs, *H. albiceps* also occurs in similar situations in the lowlands, and there are records from Skipwith Common and Thorne Moors; specimens were reported as being 'abundant' at the latter site in 1969.

*Schoenophilus versutus* is a tiny (2mm) dull grey fly of undistinguished appearance which can easily be overlooked in the field. The first Yorkshire record was in 1948 at Gristhorpe Bay (VC62) on the coast south of Scarborough and then followed reports from Great Close Mire and Ha Mire in the 1954/8 survey at Malham (Henson, *loc. cit.*). There was a further record for the former site at Malham in 1993. The only other reported County site is Fen Bog, where single specimens were found in July 2013 and 2014.

*Rhaphium longicorne* is a well-known member of the dipterous fauna of peat bogs, mainly in the uplands but also in similar lowland places (Crossley, 2014), and this spectacular dolichopodid is frequent at Fen Bog.

*Syntormon zelleri* has been known in Yorkshire since first being recorded in 1982 at Catcliffe Flash (VC63). Three years later it was found at Sug Marsh at Timble (VC64), and since then there have been reports from five sites on the North York Moors in addition to Fen Bog, where it was first recorded in 1988. There is a recent (2009) lowland record from the tiny conservation area at the Yorkshire Air Museum, Elvington (VC61) near York. This is only c.10km from Askham Bog and the fly may well be there, awaiting discovery!

In the foregoing account nomenclature follows Chandler (1998 with updates) and threat statuses are in Falk & Crossley (2005).

**Acknowledgements**
As always, a huge debt is owed to past and present entomologists who have given of their time to submit, and in some cases to maintain, the records of the Yorkshire Naturalists' Union, without whose efforts articles such as this could not be written. It is my privilege to maintain the dolichopodid records at the present time and full details concerning any species noted in this paper will gladly be provided on application.

All records pertaining to reserves of the Yorkshire Wildlife Trust are deposited with the Trust, and it is a pleasure to record my thanks for the support received from Officers of the Trust in this and other studies over more years than I now care to remember!

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## Erratum

The Spurn Bird Observatory was established in 1946 under the auspices of the Yorkshire Naturalists' Union at Warren Cottage on the Spurn peninsula. It is now a separate trust. The Yorkshire Wildlife Trust (then the Yorkshire Naturalists' Trust) bought Spurn from the Ministry of Defence in 1959 but did not create the bird observatory as I erroneously stated on p.36 of my recent article (Moore 2015). I thank Jan Crowther and Barry Spence for bringing this to my attention.

**P.G. Moore**

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# Geological and land use influences on Badger sett densities across South Yorkshire

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**Introduction**

Badgers *Meles meles* generally prefer to excavate their setts into a steep or even vertical surface (Paget & Middleton 1969, 1974); it is therefore understandable that their distribution should reflect the prevailing topography and geology. From data available in the archived Mammal Society Yorkshire Badger Sett Survey files and data from Mike Dyson, one-time member of the South Yorkshire Badger Group, it has been possible to examine the geographical distribution of 208 setts known to be active from 1974 to 1988 across the Metropolitan County of South Yorkshire. This has revealed an intriguing association with the exposed solid geology, the history of human exploitation of mineral resources, the management of arable agricultural landscapes across the Holocene drift geology and the fluctuating performance of the Sherwood sandstone aquifer in the east of the region.

By counting the numbers of 1 km squares of the Ordnance Survey National Grid north and south along a line of 64 1 km squares from west to east of the Metropolitan County, those squares known to contain setts were expressed as a percentage of the total at each easting. By plotting the percentage scores along the line of the 64 eastings, a pattern of sett preference was revealed in Figure 1.

Examination of the solid and drift geological maps of the British Geological Survey for the Sheffield, Barnsley, Doncaster and Goole regions has shown a rationale for the uneven distribution. Geological divisions which run conveniently in five belts from west to east, commence with the Carboniferous Namurian Millstone Grit, the Westphalian Lower coal measures, the Middle coal measures, often overlain by alluvium of the Don and Dearne valleys, the Permian Magnesian Limestone and marl ridge, the Triassic Sherwood sandstones overlain by the 25 ft drift of the bed of the post-glacial Lake Humber and by deposits of morainic and glacio-fluvial debris.

The tough Millstone Grits of the Pennine Peak District (between OS easting 12 and 18) are occupied, but relatively sparsely compared with the Westphalian Lower coal measures (within OS eastings 19 to 32) which provide more friable strata including sandstones, coal, shale and clay. These form the 'exposed' coalfield, where strata have been worked at the surface. Over the centuries, the landscape has been pitted by hundreds of disused shallow mine workings (including large numbers of 'bell pits', now abandoned and wooded), quarries and clay pits. This industrial heritage has provided numerous artificially excavated structures which badgers have taken over and developed as sett systems. These occupied sites are particularly resistant to illegal badger digging and are therefore disproportionately represented across South Yorkshire (Mike Dyson pers. comm.).

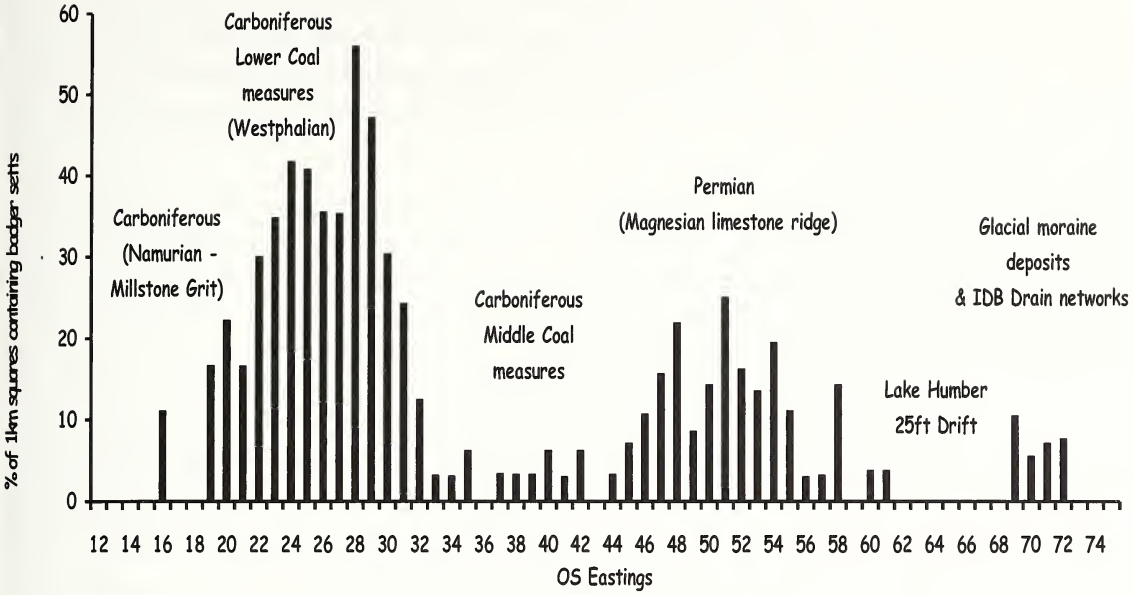


Figure 1: Relative frequencies of Badger setts across the geological zones of South Yorkshire (1974-1988).

The alluvial river washland landscapes of the Don and Dearne valleys overlie parts of the Westphalian Middle Coal measures (within OS eastings 33 to 44) to the west of the Permian Magnesian Limestone ridge. This was commercially exploited by deep mine technology offering fewer opportunities for sett excavation and those that are present in the landscape are subject to high levels of illegal badger digging.

Figure 2. A badger sett under the Permian limestone, which is visible immediately above the entrance. *P. Simmons*

A second favoured area for sett creation, from OS eastings 45 to 58, is provided by the Permian limestone and marl ridge. The underlying basal Permian sand, revealed largely along the western escarpment of the ridge, is particularly favoured by badgers for the excavation of setts (Fig. 2), as are the numerous fissures and crevices exposed by quarries and disused railway cuttings.

Across the low-lying bed of the former Lake Humber, from OS eastings 59 to 75, setts are largely absent. This is probably due to a relatively high water table and a notably flat landscape. Islands of occurrence do occur in a series of slightly elevated areas of moraine and glacio-fluvial erratic debris, between OS eastings 69 and 72 as at Lindholme Island on Hatfield Chase. Human constructions in the form of flood embankments and the faces of networks of Internal Drainage Board ditches and drains are increasingly being utilised (Mike Dyson pers. comm.). Exploitation of these sites appears to be a post 1970s phenomenon, coinciding with the lowering water table, through agricultural irrigation and over-exploitation for public supply of the underlying Sherwood sandstone aquifer.

**Acknowledgements**
I am greatly indebted to Ron Deaton of the Harrogate Naturalists' Society for making available the Mammal Society Yorkshire Badger Sett Survey files and Mike Dyson for his exhaustive knowledge of former badger setts across South Yorkshire.

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# Increase in bog-mosses *Sphagnum* and other changes in the vegetation of Ringinglow Bog (Southern Pennines) since the 1940s

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**Introduction**
It is well known that bog-mosses typically thrive on cold, nutrient-poor upland bogs where they can out-compete vascular plants and are responsible for the bulk of peat deposition (e.g. van Breemen, 1995). By the mid-20th century it was recognized that the blanket bogs of the Southern Pennines were atypical: bog surfaces were often dominated by cotton-grasses

(Common Cottongrass[4] and/or Hare's-tail Cottongrass) while bog-mosses were few or absent (e.g. Pearsall, 1950; Anderson & Shimwell, 1981). Nevertheless, studies of stratigraphy showed that much of the peat deposits underlying the current vegetation had been formed from bog-mosses (Tallis, 1964) while Pearsall (*loc.cit.*) reported an account of upland blanket bog in the area with great abundance of bog-mosses as recently as 1813. Potential reasons for the loss of bog-mosses include changes in drainage, grazing pressure and moor-burning regimes but the likely cause that has been most stressed is deposition of atmospheric industrial pollutants. The industrial conurbations of Sheffield and Manchester are close by and Tallis (1965, 1985) showed that blanket bog in the Kinder-Bleaklow area had surface deposits, <10-cm deep, of soot-contaminated humified peat overlying peat that was formed from bog-mosses; the discontinuity appears to have occurred since about 1800 and is aligned with the development of manufacturing industry and a general increase in coal burning.

Experimental evidence supports the hypothesis that atmospheric pollution has been responsible for loss of bog-mosses. For example, Ferguson *et al.* (1978) used laboratory experiments to demonstrate inhibition of extension growth, chlorophyll synthesis and photosynthesis in diverse bog-mosses at concentrations of bisulphite ($HSO_3^-$) and sulphate ($SO_4^{--}$) that were commensurate with concentrations in Sheffield and Manchester rain in the 1970s. Subsequent field experiments (Ferguson & Lee, 1980) showed that bog-mosses at an unpolluted site in North Wales were inhibited by application of artificial rain that contained bisulphite and sulphate at 1970s Sheffield-Manchester-region concentrations. It has also been suggested that high concentrations of combined inorganic nitrogen in acid deposition may disrupt nitrogen metabolism and retention by bog-mosses (Press & Lee, 1982; Press *et al.*, 1986) and lead to disruption of the nitrogen regime of bog surfaces and upset of interactions between bog-mosses and vascular plants, to the detriment of the bog-mosses (Woodin & Lee, 1987; Gunnarsson *et al.*, 2004).

This article is concerned with an area of blanket bog in the Southern Pennines that was given the name "Ringinglow Bog" by Conway (1947). Ringinglow Bog forms part of the Eastern Peak District Moors SSSI and lies at altitude c.400m within National Grid monads (1km x 1km squares) SK2583, 2683, 2783, 2584, 2684, 2784 and 2682; Upper Burbage Bridge (SK261830) is at the south-west corner of the bog. The bog is bordered to the south by the Hathersage-Ringinglow road, from which it extends northwards for c.1500m, and to the west by Burbage Brook, from which it extends eastwards for c.1400m. Conway (*loc.cit.*) summarized the vegetation of the bog: she described Heather, Common Cottongrass and Hare's-tail Cottongrass as dominant/co-dominant, Wavy Hair-grass as widespread and Soft-rush as locally dominant. Bog-mosses were not conspicuous, with the exception of a wetter area towards the north-western part of the bog where Flat-topped Bog-moss was abundant amongst the cotton-grasses. She stressed, however, that unconsolidated remains of bog-mosses are revealed over much of the bog if the superficial 5cm or so of deposit is scraped away and suggested that the dominance of bog-mosses was lost perhaps about 100 years before this 1940s study. She acknowledged the possible role in this of atmospheric pollution but concluded that cutting of drainage channels was a more likely cause.

[4] Scientific names which are included in the tables are not repeated in the text. Nomenclature of vascular plants follows Stace (2010) and that of bryophytes Atherton, Bosanquet & Lawley (2010).

A view more aligned to recent work, reviewed above, is that deposition from atmospheric pollution was probably the key factor at Ringinglow Bog. Evidence of extreme deposition of industrial pollutants specific to Ringinglow Bog is provided by metal concentrations in the peat (e.g. cadmium, copper, iron and lead) that greatly exceed those at unpolluted bog sites (Markert & Thornton, 1990; Jones & Hao, 1993; Gao *et al.*, 1999).

**Vegetation of the main flush area of Ringinglow Bog in the 1940s and 2014**

Conway (1949) described the vegetation of Ringinglow Bog as it was in the 1940s. Part of that study focussed on one of the wetter parts of the site that was referred to as the "main flush". This lay in the central and eastern part of the bog and, from the sketch map provided had an area of c.31ha. Conway emphasized that the term 'flush' was used to describe an area in which surface water accumulated and that its use did not imply that there was upwelling of inorganic nutrients. She described two vegetation types within the main flush: (1) an area with much Common Cottongrass (Plate IIIa, centre pages) along with dominant Hare's-tail Cottongrass (Plate IIIc, centre pages) found in the central area of the main flush; (2) wide bands to the north and south of the central area dominated by Hare's-tail Cottongrass but where Wavy Hair-grass was also important.

Conway recorded plants in 1m$^2$ quadrats at intervals of 10 paces along a c.1100m transect A-B that crossed the main flush, taking in both vegetation types, and extended onto Heather-dominated heath beyond. Her Table 1 includes the percentage frequency for occurrence of each plant in 1-m$^2$ quadrats in both vegetation types of the main flush. The site was species poor; only ten plants (five vascular plants and five bryophytes) were recorded in 20 quadrats placed in the Common Cottongrass-Hare's-tail Cottongrass vegetation type, the most frequent vascular plants were Hare's-tail Cottongrass 100%, Common Cottongrass 45% and Wavy Hair-grass 15%. Thirteen (seven angiosperms and six bryophytes) were found in 25 quadrats[5] placed in the Hare's-tail Cottongrass-Wavy Hair-grass vegetation type, including Hare's-tail Cottongrass 100%, Wavy Hair-grass 100%, Common Cottongrass 52%, Crowberry 24% and Cranberry 24%. Bog-mosses were not recorded in any of the quadrats placed on the main flush.

The author of the present article participated in an undergraduate field course to the site in May 1963 (led by Dr D. J. Boatman); my notes record abundant cotton-grasses with bog-mosses confined to ditches. A more recent visit to the main flush area was made in September 2014. The zonation of vegetation observed by Conway was in general terms still discernible from the Hathersage-Ringinglow road; the reddish leaves of Common Cottongrass gave the vegetation that it dominated a reddish tinge, making it clearly distinguishable from the greener Hare's-tail Cottongrass-dominated vegetation. Also, it was observed while walking approximately northwards from the road (beginning at SK26938307) that an initial Heather-dominated slope gave way after c.80m to Hare's-tail Cottongrass-dominated tussocky blanket bog with Wavy Hair-grass. There were abundant bog-mosses (Flat-topped and Fringed Bog-mosses) amongst the tussocks (Plate IIId, centre pages). At c.130m from the road the vegetation changed to Common Cottongrass dominance with Hare's-tail Cottongrass and Wavy Hair-grass. Bog-mosses

[5] The relevant column in Conway's Table 1 states that percentage frequencies were determined from 20 quadrats but the values given are all integers that are multiples of four hence it is likely that they are from 25 quadrats.

were also present including Flat-topped and Fringed Bog-mosses. Also present were red plants from *Sphagnum* section Acutifolia. During a subsequent visit in February 2015 it became apparent that these comprised Lustrous Bog-moss, identifiable in the field by red capitula with green centres, and Acute-leaved Bog-moss. At c.730m from the road the Common Cottongrass was lost and Hare's-tail Cottongrass became dominant again, with Wavy Hair-grass and some Purple Moor-grass; bog-mosses were abundant. At c.800m Heather again became dominant. An elongated pool orientated about east-west was found to the south-east of the main flush; it contained abundant Feathery Bog-moss with Fringed Bog-moss and Common Cottongrass (Plate IIIb, centre pages). This was presumably a remnant of the ditch complex shown on Conway's sketch map.

The plants found in the main flush area in September 2014 are listed in Table 1; also included are those found in quadrats on the main flush by Conway in the 1940s (taken from her Table 1). The principal change since the 1940s is clearly the reappearance of *Sphagnum*. The vascular plants found in 2014 were much the same as in the 1940s; all seven of those recorded in the 1940s were still there in 2014.

More systematic recording of the vegetation of the main flush was undertaken in November-December 2014. Plants were recorded in 1-$m^2$ quadrats using the Braun-Blanquet abundance scale (Kent, 2012); i.e. + = sparse, 1 = common but <5% cover, 2 = 5-25% cover, 3 = 25-50% cover, 4 = 50-75% cover and 5 = >75% cover. Acute-leaved and Lustrous Bog-mosses were not separated; liverworts, always inconspicuous, were not included in the recording. Quadrats were located, so far as possible, as described by Conway; that is, they were placed at 10-pace intervals along a transect from the Hathersage-Ringinglow road that began at SK27148316 and crossed the main flush at an alignment 40 degrees west of north. Twenty quadrats were placed across the central area of the main flush (between c.190m and 340m from the road) in vegetation that was perceived to be dominated by Common Cottongrass, and 20 quadrats were placed in the zone between the marginal heath and the central area of the main flush (between c.50m and 190m from the road) in vegetation that was perceived to be dominated by Hare's-tail Cottongrass with Wavy Hair-grass (two of these latter quadrats were placed 15m west of the transect).

The aims of the recording were:

- To test whether the subjective discernment of two vegetation types in the main flush is supported by an objective analysis of records. To this end the Braun-Blanquet scores for each species in each quadrat were re-coded and simplified; i.e. not recorded = 0; + & 1 = 1; 2 & 3 = 2; 4 & 5 = 3. The re-coded scores were used to compare quadrats on the basis of species present and their abundance using de-trended correspondence analysis (DECORANA) (Kent, 2012); *Community Analysis Package 3.0* was used (Henderson & Seaby, 2008).

- To look for statistically significant change since the 1940s in the percentage frequency of each species recorded, within both vegetation types in the main flush. Analysis of association (Campbell, 1967) was used to achieve this; a 2 x 2 contingency table was prepared for observed frequencies (number of quadrats with or without the species) in

the 1940s and 2014 and another for expected frequencies. The 1940s data were taken from Table 1 of Conway (1949). This was done for each species and each of the two vegetation types; a two-tailed chi-square test was used to look for significant differences between frequencies in the 1940s and 2014.

The Braun-Blanquet scores for 20 quadrats in the Common Cottongrass-dominated vegetation towards the centre of the main flush are available as additional electronic material (Appendix 1a). The scores for some quadrats suggest more than 100% cover but this is because of overlap of species. Nine vascular plants were recorded. The dominant Common Cottongrass was present in all quadrats and was recorded as 50-75% or >75% cover in 18 out of 20 quadrats. Hare's-tail Cottongrass and Wavy Hair-grass were also recorded in all quadrats but with much lower percentage cover; because recording was in December the Wavy Hair-grass foliage was largely withered and dead. Cranberry was inconspicuous but was found in 18 quadrats; Cross-leaved Heath was found in 11 quadrats and its cover was estimated as 25-50% in two of these. Bog-mosses were recorded in 13 out of 20 quadrats; five of these records were for cover of 25-50% or 50-75%. Species found were Acute-leaved/Lustrous, Feathery and Fringed Bog-mosses. Bryophytes were otherwise largely inconspicuous; Heath Plait-moss was recorded in three quadrats, Common Haircap in two quadrats (albeit at 25-50% in one of these) and Springy Turf-moss in one quadrat.

The Braun-Blanquet scores for quadrats on the vegetation dominated by Hare's-tail Cottongrass with Wavy Hair-grass are also available as additional electronic material (Appendix 1b). Eight vascular plants were recorded. The dominant Hare's-tail Cottongrass was in all 20 quadrats with cover estimates of 25-50% in seven quadrats, 50-75% in eight quadrats and >75% in five quadrats. Wavy Hair-grass was also in all quadrats, although largely withered and much less conspicuous. Cranberry, although inconspicuous, was recorded in 16 quadrats; Common Cottongrass was also frequently encountered being recorded in 14 quadrats, although with low values (5-25% in one quadrat, otherwise <5% cover). Bog-mosses were recorded in 17 quadrats and two species were found; Flat-topped and Fringed Bog-mosses. The latter was the most abundant, being found in 14 quadrats and conspicuously abundant in some of them (25-50% in three quadrats, 50-75% in two quadrats and >75% in one quadrat). Flat-topped Bog-moss was found in seven quadrats, being notably abundant in a few of them (25-50% in one and 50-75% in another). Otherwise, amongst bryophytes, Common Haircap was recorded in eight quadrats (at 25-50% cover in two of these) while there were occasional records of Rusty Swan-neck Moss, Silky Forklet-moss, Heath Plait-moss and Springy Turf-moss.

The DECORANA ordination plot for quadrats (Fig. 1) largely supported the initial subjective visual categorization of the main flush vegetation into two distinct types. Although there is an element of subjective judgement in the drawing of the cluster boundaries, it appears that 17 of the quadrats (prefix a) from the Common Cottongrass-dominated area were in a cluster towards the lower left of the plot while 15 quadrats (prefix v) from the Hare's-tail Cottongrass (with Wavy Hair-grass) vegetation type occupied a cluster towards the upper right of the plot. There were eight intermediate or outlying quadrats which is concomitant with the observed patchy nature of the vegetation. The species plot is available as additional electronic material (Appendix 2). This suggested that Common Cottongrass, Cross-leaved Heath, Acute-leaved/Lustrous and

Feathery Bog-mosses were important in pulling quadrats into the lower left cluster while Hare's-tail Cottongrass, Flat-topped and Fringed Bog-mosses were important in pulling quadrats into the upper right cluster.

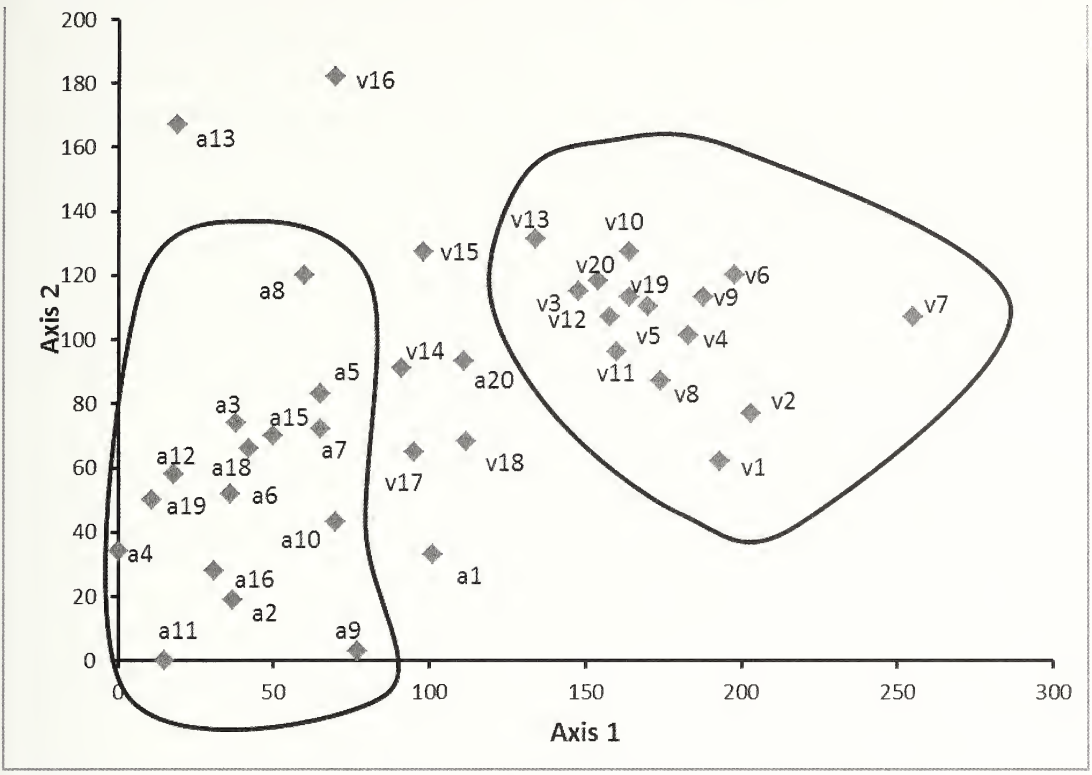


Figure 1. Ringinglow Bog, main flush area, November-December 2014; DECORANA ordination plot for quadrats. Quadrats a1-20 are for the vegetation dominated by Common Cottongrass with Hare's-tail Cottongrass ; quadrats v1-20 are for the vegetation dominated by Hare's-tail Cottongrass with Wavy Hair-grass. Points for quadrats a5 & a17 are co-incident as are those for quadrats a12 & a14. The scale on the axes indicates relative difference between the quadrats.

In the central area of the main flush, dominated by Common Cottongrass, this plant had increased significantly since the 1940s to be present in 100% of quadrats in 2014 (Table 2, p144). Three other vascular plants had significantly increased in frequency (Wavy Hair-grass, Cross-leaved Heath and Cranberry). Amongst bryophytes, bog-mosses (Acute-leaved Bog-moss/Lustrous Bog-moss, Feathery Bog-moss and Fringed Bog-moss) had increased significantly (from zero). Nodding Thread-moss had apparently been lost.

In the Hare's-tail Cottongrass (with Wavy Hair-grass)-dominated area of the main flush only Cranberry had increased since the 1940s (Table 3, p145); otherwise the vascular plants showed no significant change in frequency. Amongst bryophytes, Flat-topped Bog-moss and Fringed Bog-moss had increased significantly (from zero). Common Haircap had also increased significantly while Nodding Thread-moss had apparently disappeared.

## Discussion

The substantial increase in bog-mosses at Ringinglow Bog since the 1940s (Tables 2 & 3) can be seen in the context of the report on the recent status of bog-mosses on the Peak District moorlands that has been published by the *Moors for the Future Partnership* (Carroll *et al.*, 2009). That report accepted that gross sulphur dioxide and acid deposition from around the 1850s onward was the principal cause of the widespread disappearance of bog-mosses from the region. The report also suggests that bog-mosses are now returning to these moorlands and relates this to greatly reduced atmospheric pollution over the past 40 years, a reduction that is part of a Europe-wide improvement; since 1980 total European land-based emissions (i.e. not from shipping) of sulphur dioxide have fallen by 84% and those of nitrogen oxides by 46% (Ågren, 2013). Furthermore, Caporn *et al.* (2006) observed a marked increase of bog-mosses between the early 1980s and 2005-6 on blanket bog at Holme Moss, also in the Southern Pennines; this they concluded is likely to be due to amelioration in atmospheric pollution. Thus the increase in bog-mosses at Ringinglow Bog is liable to be, at least in part, related to reduced incidence of pollution even though it is likely that a legacy of pollutants remains in the peat.

The increase in bog-mosses in the main flush area of Ringinglow Bog has not taken place in a landscape otherwise devoid of bog-mosses. Carroll *et al.* (*loc.cit.*) reviewed Peak District records between 1989 and 2007 and showed that bog-mosses are widely distributed, albeit not necessarily abundant. Twenty were found, the most frequently recorded being Flat-topped, Fringed and Blunt-leaved Bog-mosses. Even in the 1940s bog-mosses were to be found at Ringinglow Bog (Conway, 1949), although not recorded in quadrats across the main flush. Conway recorded Flat-topped Bog-moss at frequencies of 75-85% in quadrats across an area of c.15ha that she called the "north-western flush". Blunt-leaved Bog-moss was present in one quadrat; Fringed and Lustrous Bog-mosses were also in this part of the bog although not in the quadrats and a patch of Papillose Bog-moss *Sphagnum papillosum* was found in the central part of the bog.

As is emphasized by Carroll *et al.* (*loc.cit.*) there are other environmental and management factors in addition to atmospheric pollution and its amelioration that might have contributed to the loss and recovery of bog-mosses in the Southern Pennines; these include changes in erosion, burning, grazing, trampling and drainage. Conway (1949) inferred that loss of bog mosses through erosion at Ringinglow Bog was unimportant; erosion was proceeding only slowly, in contrast with the summits of Kinder Scout and Bleaklow, and she attributed this to local topography. Nor was erosion especially obvious in 2014. Conway (1949) mentions periodic burning at Ringinglow Bog; no evidence of burning was observed in 2014. Conway also mentions sheep on the bog. Sheep grazing generally in the Peak District increased substantially in the 20th century; the number of sheep on the hills trebled between 1930 and 1976 (Anderson & Yalden, 1981). Since 2000, however, this trend has been reversed with numbers of breeding ewes in the South Pennines decreasing by 3.6% between 2000 and 2010 (Silcock *et al.*, 2012). I do not have information about whether sheep numbers have decreased at Ringinglow Bog; there were about ten sheep on the bog on 4 September 2014 and 23 on 26 February 2015. Yalden (2004) found that slow regeneration of Flat-topped Bog-moss took place over the years 1980-2004 when sheep were excluded from eroded blanket bog in the Southern Pennines, with no other treatment. He concluded that grazing and trampling had hitherto hindered regeneration. Conway (1949) concluded that artificial drainage was important in the loss of bog-mosses at

Ringinglow. Since the 1940s the ditches that she described are likely to have become more occluded, hence there may now be a higher water table. Furthermore, at least one watercourse towards the west of the bog has been blocked by a series of dams, although it is not clear to me whether this has raised water levels in the main flush area. Such gully blocking has recently become a useful technique in the management of blanket bogs (Evans *et al.,* 2005).

The preliminary visit to Ringinglow Bog in September 2014 suggested that the vascular-plant flora of the main flush area has not changed much since the 1940s because all seven of the vascular plants found by Conway (1949) were still there (Table 1). Furthermore, the overview of the site from the Hathersage-Ringinglow road suggested that Conway's separation of the main-flush vegetation into (1) Common Cottongrass with Hare's-tail Cottongrass in the central area and (2) Hare's-tail Cottongrass with Wavy hair-grass towards the margins of the flush, still holds good. DECORANA (Fig. 1), using the data from quadrats collected in November and December 2014, confirmed that there genuinely are two distinct vegetation types in the main flush area, albeit with some patchiness and overlap.

It seems, however, that there has been some recognizable change shown by vascular plants since the 1940s. This is most obvious in the central area of the main flush, where Conway described Common Cottongrass as abundant but Hare's-tail Cottongrass as dominant. Since then Common Cottongrass has increased in frequency from 45% to 100% of quadrats. Moreover, the Braun-Blanquet abundance scores for Common Cottongrass were always greater than those for Hare's-tail Cottongrass (Appendix 1a). Common Cottongrass had clearly become dominant by 2014. Other evidence of change is provided by the significant increase in frequency of Wavy Hair-grass, Cross-leaved Heath and Cranberry (Table 2, p144). The possible changes in habitat described above that might have led to the regeneration of bog-mosses (e.g. reduced pollution, perhaps less grazing and trampling) are also potentially relevant to the increase in species richness shown by vascular plants. Change has apparently been less in the Hare's-tail Cottongrass-Wavy Hair-grass vegetation towards the margin of the main flush. Here there were no significant changes in frequency except for Cranberry, which increased from 24% to 80% of quadrats (Table 3, p145).

Two vascular plants that were only occasionally seen in the main flush area in 2014 are also worth comment. Firstly, Purple Moor-grass was noted in September 2014 (Table 1, p143) and was later recorded in one quadrat (Appendix 1a). This plant was not recorded in the main flush by Conway (1949) and only sparingly in the north-western flush area. In contrast, by September 2014 there was extensive Purple Moor-grass in the north-western flush area with Hare's-tail Cottongrass and Wavy Hair-grass. Vegetation dominated by Soft-rush observed by Conway in the north-western flush persisted in 2014. Secondly, a sapling of Rowan was observed in the main flush in September 2014 (Table 1, p143) and another (height 76 cm) was later recorded in a quadrat (Appendix 1a). This incipient colonization by trees might indicate reduction in grazing.

The decrease in frequency of Nodding Thread-moss since the 1940s was the only significant change found for mosses other than increase in bog-mosses (Tables 2 & 3 pp144, 145) and Common Haircap (Table 3, p145). Indeed, Nodding Thread-moss was not recorded in 2014; Atherton *et al.*(2010) suggest that this species has declined generally in recent years.

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**Table 1.** Plants recorded in the main flush area of Ringinglow Bog in September 2014 and by Conway in the 1940s

| | **Recorded by Conway in the 1940s*** | **Recorded September 2014** |
|---|---|---|
| **Vascular plants** | | |
| *Calluna vulgaris* Heather | + | + |
| *Deschampsia flexuosa* Wavy Hair-grass | + | + |
| *Empetrum nigrum* Crowberry | + | + |
| *Erica tetralix* Cross-leaved Heath | + | + |
| *Eriophorum angustifolium* Common Cottongrass | + | + |
| *Eriophorum vaginatum* Hare's-tail Cottongrass | + | + |
| *Juncus effusus* Soft-rush | - | + |
| *Molinia caerulea* Purple Moor-grass | - | + |
| *Sorbus aucuparia* Rowan (sapling) | - | + |
| *Vaccinium myrtillus* Bilberry | - | + |
| *Vaccinium oxycoccos* Cranberry | + | + |

| | | |
|---|---|---|
| **Mosses** | | |
| *Campylopus flexuosus* Rusty Swan-neck Moss | + | + |
| *Campylopus introflexus* Heath Star-moss | - | + |
| *Dicranella heteromalla* Silky Forklet-moss | + | + |
| *Hypnum jutlandicum* Heath Plait-moss | - | + |
| *Pohlia nutans* Nodding Thread-moss | + | - |
| *Polytrichum commune* Common Haircap | + | + |
| *Sphagnum capillifolium/subnitens* Acute-leaved/Lustrous Bog-mosses | - | + |
| *Sphagnum cuspidatum* Feathery Bog-moss | - | + |
| *Sphagnum fallax* Flat-topped Bog-moss | - | + |
| *Sphagnum fimbriatum* Fringed Bog-moss | - | + |
| *Sphagnum palustre* Blunt-leaved bog-moss | - | + |
| **Liverworts** | | |
| *Calypogeia azurea* Blue Pouchwort | + | - |
| *Cephalozia bicuspidata* Two-horned Pincerwort | + | + |
| *Gymnocolea inflata* Inflated Notchwort | + | + |

(+) = present, (-) = not recorded. *Data from Table 1 of Conway (1949).

**Table 2.** Percentage frequency of plants in 1-m$^2$ quadrats in the vegetation dominated by Common Cottongrass with Hare's-tail Cottongrass in the main flush area of Ringinglow Bog in the 1940s and in November-December 2014.

| | Percentage frequency | | |
|---|---|---|---|
| | **1940s** | **2014** | ***P*** |
| **Vascular plants** | | | |
| *Calluna vulgaris* Heather | 0 | 10 | NS |
| *Deschampsia flexuosa* Wavy Hair-grass | 15 | 100 | <0.01 |
| *Empetrum nigrum* Crowberry | 10 | 10 | NS |
| *Erica tetralix* Cross-leaved Heath | 0 | 55 | <0.01 |
| *Eriophorum angustifolium* Common Cottongrass | 45 | 100 | <0.01 |
| *Eriophorum vaginatum* Hare's-tail Cottongrass | 100 | 100 | NS |
| *Molinia caerulea* Purple Moor-grass | 0 | 5 | NS |
| *Sorbus aucuparia* Rowan (sapling) | 0 | 5 | NS |
| *Vaccinium oxycoccos* Cranberry | 10 | 90 | <0.01 |
| **Mosses** | | | |
| *Hypnum jutlandicum* Heath Plait-moss | 0 | 15 | NS |
| *Pohlia nutans* Nodding Thread-moss | 25 | 0 | <0.05 |
| *Polytrichum commune* Common Haircap | 0 | 10 | NS |
| *Rhytidiadelphus squarrosus* Springy Turf-moss | 0 | 5 | NS |
| *Sphagnum capillifolium/subnitens* Acute-leaved/Lustrous Bog-mosses | 0 | 35 | <0.01 |
| *Sphagnum cuspidatum* Feathery Bog-moss | 0 | 20 | <0.05 |
| *Sphagnum fimbriatum* Fringed Bog-moss | 0 | 20 | <0.05 |

1940s records are from Conway (1949). Values are derived from 20 quadrats; NS=*P*>0.05.

**Table 3.** Percentage frequency of plants in 1-$m^2$ quadrats in the vegetation dominated by Hare's-tail Cottongrass with Wavy Hair-grass in the main flush area of Ringinglow Bog in the 1940s and in November-December 2014.

| | Percentage frequency | | |
|---|---|---|---|
| | **1940s** | **2014** | ***P*** |
| **Vascular plants** | | | |
| *Calluna vulgaris* Heather | 8 | 25 | NS |
| *Deschampsia flexuosa* Wavy Hair-grass | 100 | 100 | NS |
| *Empetrum nigrum* Crowberry | 24 | 20 | NS |
| *Erica tetralix* Cross-leaved Heath | 4 | 20 | NS |
| *Eriophorum angustifolium* Common Cottongrass | 52 | 70 | NS |
| *Eriophorum vaginatum* Hare's-tail Cottongrass | 100 | 100 | NS |
| *Galium saxatile* Heath Bedstraw | 0 | 10 | NS |
| *Vaccinium oxycoccos* Cranberry | 24 | 80 | <0.01 |
| **Mosses** | | | |
| *Campylopus flexuosus* Rusty Swan-neck Moss | 8 | 5 | NS |
| *Dicranella heteromalla* Silky Forklet-moss | 16 | 10 | NS |
| *Hypnum jutlandicum* Heath Plait-moss | 0 | 5 | NS |
| *Pohlia nutans* Nodding Thread-moss | 84 | 0 | <0.01 |
| *Polytrichum commune* Common Haircap | 4 | 40 | <0.01 |
| *Rhytidiadelphus squarrosus* Springy Turf-moss | 0 | 5 | NS |
| *Sphagnum fallax* Flat-topped Bog-moss | 0 | 35 | <0.01 |
| *Sphagnum fimbriatum* Fringed Bog-moss | 0 | 70 | <0.01 |

1940s records are from Conway (1949).

Values for the 1940s are from 25 quadrats while those for 2014 are from 20 quadrats; NS=*P*>0.05.

**Appendices 1a, 1b and 2** can be downloaded from *The Naturalist* page of the YNU website .

# Additions and corrections to the Yorkshire Diptera list (part 6)

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A small number of Diptera enthusiasts steadily continues to discover new flies in Yorkshire. Some of them are within underworked and difficult groups and were previously overlooked whereas others are recent arrivals to the county, e.g. the horsefly *Tabanus autumnalis* which was found at Fairburn Ings during July 2014 (Brothers & Grayson, 2014). Many of the additions, etc., given here are due to the work of Ian Andrews (IA), John Coldwell (JDC), Roy Crossley (RC) and Bill Ely (WAE). Most additions result from Bill Ely's prolific and longstanding recording in the Rotherham area. Ian Andrews' recent fieldwork at such regionally important sites as Allerthorpe Common and Calley Heath has produced a good number of additions to the county and VC61 lists. John Coldwell continues to investigate underworked Diptera assemblages in the Barnsley

area, which has resulted in many additions to the county and VC63 lists over many years. Roy Crossley has recently restricted his studies to Dolichopodidae, yet he continues to make new and interesting discoveries.

An updated version [dated 22.1.2015] of *A Simplified Provisional List of Yorkshire Diptera* is now available via the YNU's web-site. This list names various species as being 'excluded' from the county list, or 'queried' – usually by the determiner. It is inevitable that many of these 'queried' species would be excluded from any definitive county list, therefore the previous paper in this series (Grayson, 2014) provisionally excluded many of them. The current paper continues that process and also continues the policy of only including additions which have not been published elsewhere.

Taking into account all adjustments due to additions, corrections, species lost to synonymy and provisionally excluded, etc., the provisional Yorkshire Diptera list at 20.2.2015 contained 4,296 species, including 1,578 in the sub-order Nematocera. This is a net increase of 24 species to the list at 3.3.2013 (Grayson, 2014). This modest increase would be far greater if so many 'queried' species were not now considered 'provisionally excluded'. In the list below, (♂♂) or (♀♀) denotes that the precise number of males or females was not recorded (W.A. Ely, *pers. Comm.*).

**Additions to Yorkshire Diptera List**

CECIDOMYIIDAE

***Obolodiplosis robinae*** (Haldeman, 1847): VC63 Elmfield Park, Doncaster. Gall on False Acacia *Robinia pseudoacacia* T. Higginbottom.

PSYCHODIDAE

***Telmatoscopus ambiguus*** (Eaton, 1893): VC63 woodland around Woodall and Killamarsh Ponds (SK477807) 28.6.2000 (♂♂) WAE.

SIMULIIDAE

***Simulium* (*Simulium*) *posticatum*** Meigen, 1838 [= *austeni* Edwards, 1915]: VC63 stream and marsh at Birch Wood (SK435977) 18.10.2005 (♀♀) WAE; Kilnhurst Ings (SK466977) 7.8.2006 (♀♀) WAE.

CERATOPOGONIDAE

***Serromyia ledicola*** Kieffer, 1925: VC63 Old Spring Wood (SK535811) 23.5.2001 WAE; The Deans, Listerdale (SK465922) 30.6.1991 WAE.

CHIRONOMIDAE

***Parachironomus monochromus*** (van der Wulp, 1874): VC63 Harthill Lower Reservoir (SK489802) 2.6.2005 (♂♂) WAE.

***Paraphaenocladius penerasus*** (Edwards, 1929): VC63 Sheffield Airport (SK414885) 12.8.2001 (♂♂) WAE.

***Paratanytarsus inopertus*** (Walker, 1856): VC63 Nor Wood, Roche Abbey (SK538904) 10.8.2001 (♂♂) WAE; Quarry Hills, Roche Abbey (SK5490) 28.6.1984 (♂♂) WAE.

***Psectrocladius* (*Psectrocladius*) *limbatellus*** (Holmgren, 1869): VC63 Thurcroft Colliery tip (SK503906) 27.9.2003 (♂♂) WAE.

HYBOTIDAE

***Platypalpus incertus*** (Collin, 1926): VC63 Dalton, Huddersfield (SE157169) 30.5.2014 (2♀) Gavin Boyd det. RC, *teste* Adrian R. Plant. Both specimens are now deposited in the National Museum of Wales in Cardiff (RC, pers. comm.).

DOLICHOPODIDAE

***Chrysotus collini*** Parent, 1923: VC61 Reighton Cliffs, (clay cliffs) (TA1476) 26.6.2013 (3♂) RC.

***Medetera bispinosa*** Negrobov, 1967: VC62 Cayton Bay 5.7.1990 (♂) RC. Male genital examination is necessary to separate this species from *M. nitida* (Macquart, 1834), which was added to the Yorkshire list by Skidmore (1985). British records of *M. nitida* may all refer to *M. bispinosa* (RC, pers. comm.).

PHORIDAE

***Megaselia brunneipennis*** Costa, 1857: VC65 Thorpe Perrow Arboretum (SE2585/2685) 17.7.1982 (♂♂) WAE.

***M. collini*** (Wood, 1909): VC63 Don Canal towpath, Holmes Lock(SK415923) 13.8.2000 (♂♂) WAE.

***M. stichata*** (Lundbeck, 1920): VC63 Birch Wood (SK437978) 18.10.2005 (♂♂) WAE; Herringthorpe Wood (SK458919) 11.10.2005 (♂♂) WAE; Old Spring Wood (SK533810) 30.8.2000 (♂♂) WAE.

***Triphleba smithi*** Disney, 1982: VC63 Quarry Hills (SK541901) 6.5.2000 (♂♂) WAE.

PIPUNCULIDAE

***Chalarus gynocephalus*** Jervis, 1992: VC63 Old Spring Wood (SK535811) 19.7.2000 (♂♂) WAE.

***Eudorylas kowarzi*** (Becker, 1898): VC63 Barrow Colliery (SE3503) 5.6.2013 (♂[dissected]) JDC.

AGROMYZIDAE

***Agromyza lithospermi*** Spencer, 1963: VC63 Wath Wood Drive, Swinton (SK439991) 1.6.2011, leafmine in forget-me-not Dean Stables; VC64 Hayton Wood near Aberford (SE445381) 7.2008, leafmine in Common Gromwell *Lithospermum officinale*, Chris S. V. Yeates.

***A. sulfuriceps*** Strobl, 1898: VC64 Newton-in-Bowland (SD6950) 1.8.2011, leafmine in Meadowsweet *Filipendula ulmaria* WAE; Swinsty Moor Plantation (SE1843) 17.9.2011, leafmine in Raspberry *Rubus idaeus* WAE.

***Cerodontha (Dizygomyza) iridis*** (Hendel, 1927): VC63 Sheffield Airport (SK414885) 12.8.2001 (♂♂) WAE.

***C. (D.) morosa*** (Meigen, 1830): VC63 Maltby Low Common (SK544914) 5.6.1983 (♂♂) WAE.

***Liriomyza eupatoriana*** Spencer, 1954: VC63 Greasbrough Street, Rotherham (SK426931) 7.8.1991 WAE.

***L. flavopicta*** Hendel, 1931: VC63 Treeton Wood (SK445867) 25.5.2000 (♂♂) WAE.

***Melanagromyza cunctans*** (Meigen, 1830): VC63 Dodworth (SE3105) 3.7.2013 (♂) JDC; Edderthorpe Ings (SE4106) 29.6.2013 (♂) JDC; Haigh (SE3011) 17.11.2013 (♂), 25.7.2014 (♂) JDC; Old Moor (SE4202) 19.6.2013 (4♂) JDC; Rabbit Ings (SE3711) 26.6.2013 (♂), 21.9.2013 (♂[dissected]) 3.9.2014 (♂) JDC; all taken where Bird's-foot-trefoil *Lotus corniculatus* occurs at these Barnsley area sites (JDC, pers. comm.).

***M. eupatorii*** Spencer, 1957: VC63 Maltby Common (SK548914) 8.6.1991 WAE; Shireoaks Quarry (SK5481) 5.6.1985 WAE.

***Ophiomyia collini*** Spencer, 1971: VC63 Thundercliffe Grange (SK379937) 3.8.1997 WAE.

***O. melandricaulis*** Hering, 1943: VC63 Quarry Hills (SK5490) 18.5.1986 WAE.

***O. orbiculata*** (Hendel, 1931): VC63 Edderthorpe Ings (SE4106) 29.6.2013 (♂[dissected]) JDC.

***Phytomyza* (*Phytomyza*) *artemisivora*** Spencer, 1971: VC63 Swinton Lock Adventure Park (SK464991) 26.6.2003, leafmine in Mugwort *Artemisia vulgaris* WAE.

***P.* (*P.*) *conii*** Hering, 1931: VC61 Catwick (TA1345) 25.7.2011 WAE; VC63 Broad Lane, Sykehouse (SE6317) 21.5.2011 WAE; VC64 Thwaite Mill, Leeds (SE3231) 27.7.2011 WAE; all recorded from leafmines in Hemlock *Conium maculatum*.

***P. (P.) fulgens*** Hendel, 1920: VC63 Dodworth, by Whinby Road (SE3105) 2013, leafmines quite common in Old Man's Beard *Clematis vitalba* JDC (*teste* Andy N.R. Godfrey [ANRG]).

***P.* (*P.*) *pastinacae*** Hendel, 1923: VC63 Rainborough Park (SK402995) 28.7.1988 (♂♂) WAE.

SARCOPHAGIDAE

***Metopia staegeri*** Rondani, 1859: VC61 Allerthorpe Common (SE755480) 17.7.2013 (♂) IA det. Daniel Whitmore; Calley Heath (SE751498) 4.6.2014 (♂), 15.6.2014 (♂) IA.

TACHINIDAE

***Dufouria chalybeata*** (Meigen, 1824): VC61 Allerthorpe Common (SE755480) 30.5.2014 (♂) IA (*teste* Chris Raper [CR]); Calley Heath (SE751498) 4.6.2014 (♂) IA.

***Gonia picea*** (Robineau-Desvoidy, 1830): VC61 Allerthorpe Common (SE755480) 26.3.2012 IA (*teste* CR).

***Phryxe heraclei*** (Meigen, 1824): VC61 Allerthorpe Common (SE755480) 28.7.2014 (♂) IA.

***Subclytia rotundiventris*** (Fallén, 1820): VC63 Haigh (SE3011) 17.6.2013 (♀) JDC.

**Re-instatements to Yorkshire Diptera List**

CECIDOMYIIDAE

***Neurolyga truncata*** (Felt, 1912) [= *hammi* (Edwards, 1938)]: VC63 Lindrick Golf Course (SK544824) 1986 Richard J. Hall; Roche Abbey (SK5489) 1985 John Pearson. Both these records are ex Rotherham Data Bank sub nom. *Cordylomyia hammi* and were of galls on Lady's Bedstraw *Galium verum* (WAE, pers. comm.). *N. truncata* was provisionally excluded by Grayson (2006c).

***Rhopalomyia palearum*** (Kieffer, 1890): VC64 Ling Ghyll (SD8078) 8.8.1987, gall on Yarrow *Achilea millefolium* WAE. This [sub nom. *Misospatha palearum*] was excluded from the Yorkshire list by Grayson (2005) as the only record known to him at the time was a transcription error.

CHIRONOMIDAE

***Cricotopus* (*Isocladius*) *ornatus*** (Meigen, 1818): VC63 Chesterfield Canal (SK507823) 18.6.2000 (♂♂) WAE; Thrybergh Tip (SK460960) 12.7.2001 (♂♂) WAE. This non-biting midge was formerly excluded by Grayson (2009).

DOLICHOPODIDAE

***Dolichopus* (*Dolichopus*) *caligatus*** Wahlberg, 1850: VC65 Marske, by river (SE113994) 13.7.2008 ANRG. An earlier record was stated to be a transcription error by Grayson (2006d).

SYRPHIDAE

***Volucella zonaria*** (Poda, 1761). This very large hoverfly can here be excluded from the county list and re-instated again by virtue of the following notes. *V. zonaria* was recorded from the York area by Fife & Walls (1973); however, the record is suspect and can be discounted without serious misgivings. All Diptera identifications in Fife & Walls (*loc. cit.*) are questionable, some being obviously erroneous and others very doubtfully authentic. The next published mention of *V. zonaria* in Yorkshire was by Stubbs (2005), followed by

enumeration of the relevant record by Grayson (2006a). These referred to a sighting of *V. zonaria* on the Yorkshire side of the River Rother in Rother Valley Country Park by WAE in 2004; however, WAE (pers. comm.) subsequently reported that the River Rother was re-routed since Watson defined his vice-county borders and his sighting was on land in the neighbouring VC57 (Derbyshire). The re-instatement of *V. zonaria* is due to Brian Smith's photographs of a ♀ on Butterfly Bush *Buddleia davidii* in his garden in Hilda Street, Goole, on 26.8.2013. Two good photographs were forwarded to me by Peter Kendall for verification of this record.

LONCHAEIDAE

***Lonchaea scutellaris*** Rondani, 1874: VC65 Thorpe Perrow Arboretum (SE2585/2685) 17.7.1982 WAE. This fly was recorded from Yorkshire in MacGowan & Rotheray (2008) but provisionally excluded by Grayson (2014).

**Exclusions from Yorkshire Diptera List**

MYCETOPHILIDAE

***Mycetophila bohemica*** (Laštovka, 1963). Falk & Chandler (2005) stated "A record from Studley Royal Park, Yorkshire, requires confirmation". This refers to a ♀ taken at SE287691 on 19.6.1989 by Peter Skidmore and tentatively identified by him with the note "queried as this species". There is no specimen standing under *M. bohemica* in Doncaster Museum and Art Gallery. On this basis, *M. bohemica* is best provisionally excluded from the Yorkshire list.

***Phthinia humilis*** Winnertz, 1863. This fungus gnat is best provisionally excluded from the county list pending verification of its occurrence in Yorkshire. The three Yorkshire records are from 1980-1982; therefore, specimens require re-examination, as they are likely to be *P. mira* (Ostroverkhova, 1977) (JDC, pers. comm.).

CECIDOMYIIDAE

***Contarinia acetosellae*** (Rübsaamen, 1891). The gall of this midge would appear to have been erroneously recorded from Yorkshire due to a transcription error. It was listed by Grayson (2007) on the basis that it was recorded from Yorkshire by Bagnall & Harrison (1918) as their species no. 266, according to John Robbins (pers. comm.). However, there is no such record.

CERATOPOGONIDAE

***Forcipomyia* (*Thyridomyia*) *monilicornis*** (Coquillett, 1905). This biting midge was tentatively recorded as "? this sp." from Hatfield Moors by Skidmore (2001). There is another Yorkshire record on the Malham Tarn cards, viz. "5.8.1978, North Wing ♀ (runs to *F.palustris* in Edwards, 1926: no literature on rest of sub-genus, *Thyridomia* available) RHLDisney". *F.* (*T.*) *palustris sensu* Edwards (1926) is synonymous with *F.* (*T.*) *monilicornis* (Coquillett) but there are two other British *Forcipomyia* in the sub-genus *Thyridomyia*, of which *F.* (*T.*) *rugosa* Chan & Le Roux, 1970, was recorded from Yorkshire by Boorman (1974) [from the Rothwell area of Leeds, det. M.W. Service]. Provisional exclusion of *F.* (*T.*) *monilicornis* from the county list would appear logical, given the degree of doubt about its occurrence in Yorkshire.

AGROMYZIDAE

***Cerodontha* (*Butomomyza*) *eucaricis*** Nowakowski, 1967. The record from Skipwith Common in Grayson (2006b) was a misidentification for *C.* (*B.*) *scutellaris* (von Roser, 1840) (J.H. Cole, pers. comm.).

***Phytomyza* (*Phytomyza*) *pauliloewii*** Hendel, 1920. Spencer (1972) mentioned leafmines on Burnet-saxifrage, stating "*Pimpinella saxifraga* L. Yorks.: nr. Settle, 30.vii.62 (G.C.D. Griffiths). Whitish blotch mines (brown when old) of a *Phytomyza* sp., possibly referable to ***Phytomyza pauli-loewi*** Hendel, 1920 (fig. 360)". This identification was tentative and there have been no further Yorkshire records; hence, *P.* (*P.*) *pauliloewii* is best provisionally excluded from the county list, pending verification of its occurrence.

SPHAEROCERIDAE

***Trachyopella* (*Trachyopella*) *atomus*** (Rondani, 1880). This 'lesser dung fly' is probably best provisionally excluded from the county list as Pitkin (1988) knew of only one British site, and the record in Payne (1957) probably referred to *T.* (*T.*) *lineafrons* (Spuler, 1925); however, this is not entirely certain as Payne (*loc. cit.*) intriguingly stated his specimen from Copmanthorpe on 22.9.1956 was "very small".

TACHINIDAE

***Leiophora innoxia*** (Meigen, 1824) [= *procera* sensu auctt., nec (Meigen, 1824)]. This parasitic fly is best provisionally excluded from the Yorkshire list. Belshaw (1993) stated that the only record in northern England was an unconfirmed literature record from Yorkshire. Chris Cheetham's record card [for *Hypostena procera*] probably alludes to the same record, as Cheetham wrote "Ripon dist: C Morley in litt. Hincks".

***Phebellia villica*** (Zetterstedt, [1838]) [= *ingens* (Brauer & von Bergenstamm, 1891)]. A ♀ was listed from Frog Hall in Durham, 27.8.1929 by van Emden (1954). Probably this was in error for Frog Hall at the edge of Allerthorpe Common in Yorkshire; but regardless, the review by Belshaw (1993) considered ♀ *P. villica* was indistinguishable from ♀ *P. vicina* (Wainwright, 1940).

**Further Notes**

*A Simplified Provisional List of Yorkshire Diptera* [on the YNU's web-site] is a 'work-in-progress' which lists many species as being 'excluded' from the county list or 'queried' by their determiners. Grayson (2014) regarded many of these 'queried' species as warranting provisional exclusion from any definitive county list. No records have been published for any of the following 'queried' species, which also warrant provisional exclusion: PSYCHODIDAE: *Psychoda erminea* Eaton, 1898: DOLICHOPODIDAE: *Dolichopus* (*Dolichopus*) *mediicornis* Verrall, 1875: AGROMYZIDAE: *Phytomyza* (*Phytomyza*) *murina* Hendel, 1935 [=*brevicornis* sensu Brit. auctt., nec Hendel, 1934]: and EPHYDRIDAE: *Parydra* (*Chaetoapnaea*) *hecate* (Haliday, 1833).

ASILIDAE

Ken Payne's record lists [in 13 folders now in the YNU archives] contain an intriguing unpublished record of the robber-fly *Eutolmus rufibarbis* (Meigen, 1820), which may be correct. However, it would represent a remarkable find and no voucher specimen has thus far been located. As the asilid involved may have been a *Machimus*, then provisional exclusion from the Yorkshire list is desirable. Ken's record was of a ♂ from Snake Hill Plantation, North Cave (SE8634) 4.7.1981, with the note that it was initially recorded as *Philonicus albiceps* (Meigen, 1820).

DOLICHOPODIDAE

Writing on the fauna of Beacon Lagoons Nature Reserve near Spurn, Cook (2009) mentioned "a Dolichopodid fly (*Tachytrechus hyallipennis*), not previously recorded in Yorkshire." This refers to *Tachytrechus insignis* (Stannius, 1831) taken from an old drainage ditch by RC (RC, *pers. comm.*). There is no such species as *T. hyallipennis*. The first published Yorkshire record of *T. insignis* is contained in Chandler (2002).

**Acknowledgements**

This paper would not have been possible without information and co-operation from the following: Ian Andrews, John Coldwell, Jon Cole, Roy Crossley, Bill Ely, Andy Godfrey, Tom Higginbottom, Peter Kendall and Chris Yeates.

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# YNU VC63 Field Excursion to Thorpe Marsh 14th June 2014 Bryology Report

**Colin Wall**

The old railway embankment bisecting the reserve from east to west was probably the most productive area for the bryologist. With a substrate rich in acid clinker/ash and basic slag ballast, it exhibited a high degree of opportunity for both calcicoles and acidophiles, and a variety of common examples from both persuasions had become established, interspersed with more neutral species. Within a footfall of acid-loving *Campylopus introflexus* and *Brachythecium albicans* could be found calcicoles such as *Plagiomnium undulatum* and *Didymodon insulanus,* against a general background of neutral and ubiquitous *Brachythecium rutabulum* and *Kindbergia praelonga*. Small acrocarps such as *Pseudocrossidium hornschuchianum, Barbula unguiculata* and *B. convoluta* had become established where the substrate had become hard-packed. The embankment, shaded by mature oaks and hawthorns, had *Fissidens taxifolius* and *F. bryoides* with a little *Mnium hornum* and *Polytrichum juniperinum.*

Despite the virtual absence of suitable host trees for epiphytes (only two Ash trees were noted), the oaks supported a number of mosses that were rare only ten years ago but are now thriving due to the reduction of atmospheric sulphur dioxide levels. These included *Ulota bruchii, U. phyllantha, Cryphaea heteromalla, Orthotrichum affine, O. diaphanum* and *O. lyellii.* The latter is still scarce in the Doncaster area, so it was pleasing to see it on Ash, though it was first found on the reserve in 2011 on oak. Other epiphytes included the liverworts *Frullania dilatata* and *Metzgeria furcata*, both on oak.

On the day 43 species of bryophytes were recorded, compared to 49 recorded on visits in 2009 and 2011. There were, however, five that had not been previously recorded. Among these was

the thalloid liverwort *Pellia epiphylla,* the flap-like involucre in evidence. The most surprising addition to the reserve's list was a very small amount of the tiny *Leskea polycarpa* on Elder at the foot of the embankment.

## Botanical Report for 2014

**Phyl Abbott, Richard Middleton, Gill Smith & Linda Robinson**
Email: phyl.a@virgin.net

**VC61 South-east Yorkshire**

The greater part of all botanical recording activity during 2014 was directed towards achieving good coverage for the forthcoming Atlas 2020. This has resulted in a great many new records but mainly for more common-place plants in areas which have been less well recorded. All records for rare and scarce plants have been published in the 3rd Edition of the Rare Plants Register (Middleton & Cook 2015). There was, of course, the occasional surprise. Among these was a clump of Monk's-hood *Aconitum napellus* on the verge at Thwing; obviously an introduction but matching a herbarium specimen collected by Professor Ron Good from this locality in 1956! The 'square bashing' also provided useful records for Spiny Restharrow *Ononis spinosa* and Lesser Hawkbit *Leontodon saxatilis* on the Humber banks at Paull Fort. Less welcome was the large quantity of New Zealand Pigmyweed *Crassula helmsii* in the village pond at Fimber (John Killingbeck).

Over the previous winter, storm surges re-modelled the landscape around Kilnsea and Spurn. Large amounts of sand were moved and it was feared that much damage would have been done to the flora. The large patch of Intermediate Polypody *Polypodium interjectum* south of the Warren Cottage seems to have succumbed but, rather surprisingly, Sea-holly *Eryngium maritimum* now seems to be thriving on the dunes between Kilnsea and Easington and the upper strand-line in this area has sprouted a long line of the UK BAP species Prickly Saltwort *Salsola kali* subsp. *kali*.

There were two records this year for Small-flowered Catchfly *Silene gallica*, the first this millennium, from farms in the Vale of York. Although neither is thought to have been a deliberate introduction, caution must be exercised in interpreting these occurrences as they were both near areas where other cornfield flowers had been seeded.

The late May Botanical Section meeting in Millington Dale was notable for a large well-spread colony of over 100 flowering spikes of Frog Orchid *Coeloglossum viride*, found by Martin Stringer; this is a site for which there seem to be no previous records. The cliffs between Reighton and Speeton provided several sites for Grass-of-Parnassus *Parnassia palustris*, a plant which is now confined in the vice-county to Filey Bay. Alerted to its presence by Sarah White, it was good to see it growing so well. It was with Felwort *Gentianella amarella* in areas that had, earlier in the year, produced a profusion of Pyramidal *Anacamptis pyramidalis* and Fragrant Orchids *Gymnadenia conopsea*.

Two notable sedge records were Pale Sedge *Carex pallescens*, found by Gabrielle Jarvis and Rohan Lewis near Houghton Hall and considered rare in the vice-county, and a patch of Divided Sedge *Carex divisa* at Skeffling, last recorded by Eva Crackles in 1956 and now re-discovered by Peter Cook.

The South-east Yorkshire Rare Plants Register (RPR) is available for free download from the VC61 BSBI pages: http://www.middleton12.karoo.net/.

**Richard Middleton**

**VC62 North-east Yorkshire**

These notes are heavily biased to Ryedale as I received no other records, nor did I botanise in other parts of the vice-county myself. 2014 had a remarkably mild start, with plenty of sunshine in Ryedale.

Snowdrops *Galanthus nivalis* were more or less fully out by 1 February and at their best to 24 Feb. White and purple Sweet Violets *Viola odorata were* flowering nicely near Whitwell by 12 March. Blackthorn *Prunus spinosa* was out by 9 April, and Wild Cherry *Prunus avium* and Plum *Prunus domestica* were opening. On 24 April both golden saxifrages were flowering together near Hovingham, but there was no sign of the Greater Chickweed *Stellaria neglecta*. I counted 24 Early-purple Orchids *Orchis mascula* on the roadside just south of Gilling with a few hybrid False Oxlips *Primula x polyantha* nearby.

Herb Paris *Paris quadrifolia* was doing very well in Gilling with 50+ plants. The Baneberry *Actaea spicata* was weak though, with one plant of the three broken/eaten, probably by deer, and only one showing flowers and on only one spike. Those on the east side of the road at Ashberry were faring poorly but the plants on the west side were strong and healthy, though again with only one flower spike.

On the Ryedale Naturalists' trip to Raindale on 11 May it was good to re-find Intermediate Wintergreen *Pyrola media* in the same spot (SE806924) where it had been seen 50 years before by Gordon Simpson. He also showed us Dwarf Willow *Salix herbacea* at SE813923. Bob Dicker, via Nan Sykes, reported quite a good population of the wintergreen not far from the 'fire tower', or Red Dyke (at c. SE892887), on 19 June.

Globeflower *Trollius europaeus* was reported in woodland at Beadale, Wrelton. This is an old site but it hadn't been seen for several years, so it's great to have it back. In Spaunton Quarry (SE7287) on 20 May we found a swathe of Adders-tongue *Ophioglossum vulgatum* – 100 or more plants under bracken , as well as some Fly Orchids *Ophrys insectifera*.

Hairy Rock-cress *Arabis hirsuta* and Knotted Clover *Trifolium striatum* were both in flower at Hutton Common (SE7088) on 5 June. There was a small patch of the former of about 20 stalks, and three small clumps of Knotted Clover.

As a result of some wet weather all the roadside vegetation grew incredibly tall and lush. Southern Marsh-orchids *Dactylorhiza praetermissa* at Castle Howard Arboretum were spectacular on 11 June. Horse-radish *Armoracia rusticana* on a roadside verge at Whitwell produced a flower spike – the first I can remember seeing.

Roy Crossley recorded Lesser Water-plantain *Baldellia ranunculoides* in flower on 16 June on the shore of a recently created pod/scrape near a track within the Strensall Common MOD Danger Area at ca. SE650595.

A small colony of Bee Orchids *Ophrys apifera* in a clearing in Gilling Woods, which I have been watching for a few years, produced 13 spikes this year, some very tiny with only one flower, but the highest number so far. There were two Bee Orchids at Bull Ings , which is good as I didn't see any there last year. Eight Fragrant Orchids *Gymnadenia conopsea* and Pepper-saxifrage *Silaum silaus* were just coming into flower on 4 July.

In late June/early July something very nasty affected willows, notably Goat Willow *Salix caprea,* around Gilling. A combination of rust and beetle attack meant that many trees looked dead by mid July, although some, at least, tried to put out new shoots. In the second half of July there was perfect summer weather. A plant of Welted Thistle *Carduus crispus* was found near Gilling on a field edge (SE6276) on 20 July.

It was a poor acorn year, though good for beech mast, hazel nuts, plums, haws and some blackberries – but plenty of knopper galls. The end of October to mid November was remarkably warm and quite wet. There was poor autumn colour, as there was no frost.

A further species list is available from the YNU website www.ynu.org.uk.

**Gill Smith**

**VC63 South West Yorkshire**
Report not available.

**VC64 Mid-west Yorkshire**
Many interesting plants were seen during field meetings of the Bradford Botany Group. Among an extensive display of Bluebells *Hyacinthoides non-scripta* at Rougement Carr in April, a few had pink (var *rosea*) or white (var *alba*) flowers. Also in the woodland were a few spikes of Toothwort *Lathraea squamaria* and in the nearby Weeton churchyard at SE283465 the Goldilocks Buttercup *Ranunculus auricomus* was surprisingly frequent. During the visit to Park Rash on 7 June, in monad SD9774 Mountain Everlasting *Antennaria dioica* and Fragrant Orchid were found and in SD9874 Pyrenean Scurvygrass *Cochlearia pyrenaica*, Bird's-eye Primrose *Primula farinosa,* and Globeflower.

On the naturally revegetated Sun Lane tip at Burley-in-Wharfedale, SE1546, on 23 July, we saw Small Teasel *Dipsacus pilosus* in one of its seven sites in VC64, Water Violet *Hottonia palustris*, and several alien species including Stinking Iris *Iris foetidissima* in its third site in VC64 and Filbert *Corylus maxima*, a new plant for the vice-county. On 26 July the Attermire and Langcliffe reserve in SD8365 was particularly species-rich. Finds there included Moonwort *Botrychium lunaria,* Dioecious Sedge *Carex dioica,* the hybrid between Tawny Sedge, and Long-stalked Yellow Sedge *Carex x fulva*, Autumn Gentian *Gentianella amarella*, Herb Paris, Grass of Parnassus *Parnassia palustris*, Spreading Meadow-grass *Poa humilis*, Holly Fern *Polystichum lonchitis*, Lesser Clubmoss *Selaginella selaginoides*, Limestone Fern *Gymnocarpium robertianum,* Mountain Pansy *Viola lutea,* and Green Spleenwort *Asplenium viride,* some of whose fronds were forked making it *A. viride* var. *multifidum.*

Visits to Fairburn Ings RSPB reserve, by Leeds Naturalists' Club on 16 July and by Bradford Botany Group on 21 August, boosted the total number of plants recorded in SE4527 to 327. The most intriguing plant was a dwarf Centaury, about 3 inches tall and with bright pink flowers, growing in patches alongside the Common Centaury *Centaurium erythrea* at the edge of the car park. This was identified, from photographs sent to Dr F. Ubsdell, the BSBI referee for *Centaurium*, as Lesser Centaury *Centaurium pulchellum*. Most of its British sites are in southern England with a few in coastal areas further north. The only previous records in Yorkshire were from Redcar in 1892 and 1930. It is new to VC64.

John Webb has found two new sites for Narrow-leaved Water-plantain *Alisma lanceolatum,* in the Leeds and Liverpool canal near Silsden at SE053447 and near Morton at SE092415. A steeply sloping, north-facing field in Littondale, SD9569, had a good diversity of plants including Marsh Helleborine *Epipactis palustris,* Autumn Gentian, Grass of Parnassus, Sea Plantain *Plantago maritima,* Creeping Willow *Salix repens,* and Saw-wort *Serratula tinctoria.* While monitoring plants on the Malham Tarn estate we found Jacob's-ladder *Polemonium caeruleum* in a new site to the west of the tarn and, although Alpine Bartsia *Bartsia alpina* was quite plentiful, there were no flowers this year

During the YNU meeting in SD7666, at Austwick Moss we could find only a small amount of Cranberry *Vaccinium oxycoccos* amongst the dominant Purple Moor Grass *Molinia caerulea*. In a damp hollow there was a beautifully flowering patch of Round-leaved Sundew *Drosera rotundifolia* at SD762666. Lawkland Moss had more plants of interest, including Meadow Saffron *Colchicum autumnale at* SD767666, Dyer's Greenweed *Genista tinctoria* (SD767666), Slender St John's-wort *Hypericum pulchrum* (SD767666), Blunt-flowered Rush *Juncus subnodulosus,* Bogbean *Menyanthes trifoliata*, (SD761664), Marsh Cinquefoil *Comarum palustre* (SD763667) and Saw-wort *Serratula tinctoria* (SD767666).

Rare and scarce plants in new tetrads:

| Scientific name | Vernacular name | Location | Recorder |
|---|---|---|---|
| *Dryopteris submontana* | Rigid Buckler Fern | Attermire, SD8264 | Bradford Botany Group |
| *Alchemilla glaucescens* | Silky Lady's Mantle | Sleets Gill, SD958688 | P. Abbott, B. Brown, C. Horner |
| *Primula farinosa* | Bird's-eye Primrose | Attermire, SD8264 | Bradford Botany Group |

Species new to the vice county

| Scientific name | Vernacular name | Location | Recorder |
|---|---|---|---|
| *Betula populifolia* | Grey Birch | Allerton Bywater SE414284 | P. Abbott, K. McDowell |
| *Centaurium pulchellum* | Lesser Centaury | Fairburn Ings, SE4527 | Leeds Naturalists' Club, Bradford Botany Group |
| *Corylus maxima* | Filbert | Burley-in-Wharfedale SE1546 | Bradford Botany Group |

**Phyl Abbott**

**VC65 North West Yorkshire**

Yellow Star-of-Bethlehem *Gagea lutea* was found near the Round Howe below Richmond at the end of March by Jan Owen and LR, last recorded from here in the 1960s. It was also found in Iron Banks Woodland in April, and downstream from Richmond in a few new sites by Trevor Lowis (TL) and LR. Further sightings were on the riverbank near Brompton-on-Swale and in profusion in the riverside woodland near Catterick village in April by Trevor Lowis and LR, all new sites. There is an old 1800s record for the plant near Asenby.

Henbit Deadnettle *Lamium amplexicaule* was found in April on dry banks between Catterick Bridge and Scorton by Brian Burrow (BB) and LR, and more has been spotted since then in arable fields near Ainderby Steeple and Danby Wiske later in the year. These are the first records for VC65 since the 1960s.

Juniper *Juniper communis* - a seedling found among the heather at Uldale Head by Tim & Eileen Laurie (T&EL), TL and LR in August was the second seedling spotted well away from any Juniper stands and bodes well for the plant now that grazing on the fells has reduced. The first seedling was noted just over the border into Cumbria.

Pyrenean Lily *Lilium pyrenaicum* - a few plants naturalised on the edge of the Tees about 200 yards downstream from Wynch Bridge are probably garden escapes. Spotted by LR in June.

Dwarf Mallow *Malva neglecta* was seen in profusion in the village of Danby Wiske by Allison and LR in August, it was also growing alongside tracks through arable fields around the village.

Vernal Sand-wort *Minuartia verna*, a beautiful double-flowered form was spotted by Dave Hickson and LR in June on the Ballowfield Nature Reserve in Wensleydale.

Royal Fern *Osmunda regalis* - one plant was seen by Chris Irvine and LR in the gorge at the Fairy Glen Waterfall near Holwick in Teesdale in June.

Scottish Goat Willow *Salix caprea* subsp. *sphacelata* has been found in previous years in upland gills and scars in Swaledale, Teesdale and Wensleydale. T&EL and LR spotted another ancient specimen in Hebblethwaite Gill above Hebblethwaite Hall near Sedbergh. It must have been an integral part of the original woodland which is now just hanging on in these upland gills and scars. I believe that these unique scar woodlands need protection as examples of the original 'wildwood' with its unique DNA, present after the ice melted 12,000 years ago. Planting of shrubs and trees from 'foreign' sources should be prevented to protect their unique provenance.

Hairy Stonecrop *Sedum villosum* was seen by Brian Burrow (BB) and LR in June whilst walking down Arten Gill as a small patch of around 34 plants on a flushed stream bank.

Tomato *Solanum lycopersicum* plants were found naturalised on the shingle banks on the Swale near Great Langton by LR in August. This is a new record for VC65.

During a Field trip to Morton-on-Swale we came across a drainage ditch with old fenland plants including Common Reed *Phragmites australis*, Bottle Sedge *Carex rostrata*, Brown Sedge *Carex disticha*, False Fox-sedge *Carex otrubae*, Common Meadow-rue *Thalictrum flavum* and Purple-loosetrife *Lythrum salicaria* still growing on the ditch edge. Nick Morgan got permission to visit

a garden bordering the old fen site below Ainderby Steeple the following week, where we found a remnant about quarter of an acre in size of this fen vegetation still intact bordering the old 'bottoms'. The owner of the garden had built a pond just above this remnant and the fen vegetation was spreading nicely round it. Plants found here were Skullcap *Scutellaria galericulata*, Common Meadow-rue, Bottle Sedge, Purple-loosestrife, Amphibious Bistort *Persicaria amphibia*, Common Reed and Greater Pond-sedge *Carex riparia*, all mentioned in a Yorkshire Naturalists' Union Report of a Field Meeting to Ainderby Steeple on 22 June 1946. The wet field beside this remnant fen has only just been successfully drained in the last two or three years and it's a pity that funding couldn't be found to purchase this field and re-wet it. It would make a wonderful Nature Reserve and preserve an example of the now-lost botanically rich fens and carrs, once common in this area before they were drained for arable crops in the 1950s.

**Linda Robinson**

# YNU Notice

## YNU Annual General Meeting

Notice is hereby given that the 153rd Annual General Meeting of the Yorkshire Naturalists' Union will take place at the 'Lakehouse', Ron Cooke Hub, **University of York** on **14 November 2015**. The meeting will be preceded by a meeting of the Natural Sciences Forum and followed by an address from outgoing YNU President Dr. Geoff Oxford.

The full programme for the day is as follows:

9:30 Registration
9:45 Short guided walk around the Heslington East development, led by Professor Chris Thomas FRS (expert on butterflies and climate change). Chris has been on the committee planning the environment of Heslington East from the start and will explain the thinking behind the extensive landscaping features, which include lakes, hay meadows and woodland.
10:30 Refreshments
11:00 Natural Sciences Forum
12:30 Cold Buffet Lunch
13:30 Group photo
13:45 AGM, hosted by the Yorkshire Mammal Group
14:45 Presidential Address: 'A roll of the dice: the unnatural history of Large House spiders in the British Isles.
15:30 Refreshments
16:00 Meeting close and departure

The charge for the day will be £14.00, which includes lunch.
Members may book online at www.ynu.org.uk, or with a cheque to the YNU Treasurer, Barry Warrington, Hessle Mount Farm, Jenny Brough Lane, Hessle, HU13 0JZ (treasurer@ynu.org.uk).

Details of how to get to the site can be found at: http://www.york.ac.uk/about/maps/. Parking is free on campus at weekends, and there is a car park a short walk from the venue, signposted 'Ron Cooke Hub'. Inside the building, go to the second floor, following signs to the Lakehouse.

# Book review

**Butterflies of Lesbos** and **Dragonflies of Lesbos.** ebooks by John Bowers. These ebooks will be available as free downloads when the Friends of Green Lesbos website www.greenlesbos.com is rebuilt. In the interim they are available from the author j.k.bowers@icloud.com

The subject matter of these ebooks lends itself well to this modern treatment. The author's aim is to enable general naturalists and members of the public to be able to recognise the island's butterflies and dragonflies with a minimum of need to catch specimens, other than with a camera. He provides good photographs of all of the species (including upper and lower surfaces when necessary) and each is annotated with clear identification features. Similar species are compared side by side. There are some groups of butterfies, such as Meadow Browns and Graylings where this treatment doesn't work, and the author admits that these can only be identified to genus level. He points out that greater confidence cannot be achieved by anything other than microscopic examination of dead specimens, something that he does not feel is justified for mere casual identification.

The general biology of both groups of insects is included where it will assist with finding them. Status, habitat and distribution notes are given for each species and there are introduction pages for each of the major groups and sub-groups (e.g. Whites, Graylings, Damselflies etc). Photographs and descriptions of the main habitat types on the island are useful features and a list of the larval food plants of butterflies will aid the search for a particular species, as well as identifications. Given that Lesbos can appear a hot and dry island in summer, he gives good information, with maps, of where water is present year-round and will have likely places to find dragonflies.

For many readers a difficulty of the Dragonflies book could be that, though a table of English names is given at the end, all the species descriptions mention only their scientific ones. Whilst there is unfortunately no general agreement over many of the English names, a good number (e.g. Emperor Dragonfly, Broad-bodied Chaser) are well-established and could perhaps have been included in the main text.

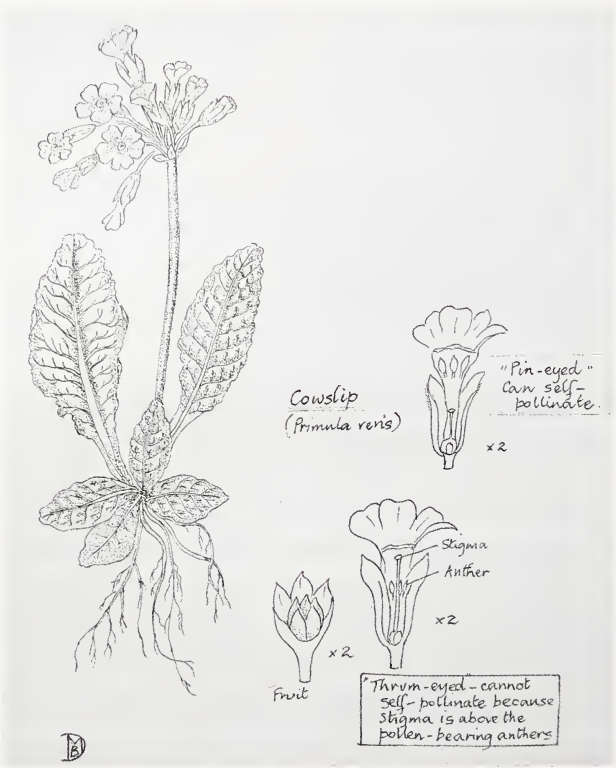
This said, the real joy of both of these ebooks is their effective use of a simple technology trick – the hyperlink. A comprehensive index and a link symbol on each page allow the user to move from page to page with a simple tap or key press. The layout is clear and consistent, though perhaps not 'polished', and there are a few textual errors which will no doubt be removed as the books evolve. The author's informal style encourages involvement and interest and because it works well on ipads and mobile phones as well as on a laptop it should allow any of us to identify the butterflies and dragonflies seen on Lesbos (and many of those seen on neighbouring islands) with confidence.

**RPS**

# YNU Calendar 2015

Up-to-date information can also be found on the YNU website at:
www.ynu.org.uk/events/general

| | | |
|---|---|---|
| Sept | 5 | Conchological Section Field Meeting. 10:30. Fridaythorpe, Driffield, East Riding of Yorkshire. For further details contact A.Norris via AdrianXNorris@aol.com. |
| Oct | 3 | Conchological Section Field Meeting. 10:30. Murton Wood, North York Moors National Park. For further details contact A.Norris via AdrianXNorris@aol.com. |
| | 10 | Bryology Section Field Meeting, Kilburn. Meet at 10:00 in the White Horse car park at SE514811. |
| | 24 | YNU Executive Meeting. 10:30 – 12:30 St Chad's Parish Hall, Headingley, Leeds |
| | 31 | Conchological section AGM.13:00 – 16:00. For further details contact A.Norris via AdrianXNorris@aol.com. |
| Nov | 14 | **AGM**, York. Preceded by Natural Sciences Forum (see details on p159). |
| 2016 | | |
| Mar | 19 | **YNU Conference** – advance notice. Theme: '*Names, knowledge and natural history – the importance of modern taxonomy to the amateur naturalist'*. At the National Science Learning Centre, University of York. |




Endpiece: Cowslip *Primula veris*, by Dorothy Bramley (see *The Naturalist* 140, 68-70)

# Yorkshire Naturalists' Union

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## The Naturalist


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**J. Bowers, W. Ely, A. Henderson, A. Millard, P. Simmons**


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